ABSTRACTS OF NORTH AMERICAN GEOLOGY

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INTRODUCTION

Abstracts of North American Geology contains abstracts of technical papers and books and also citations of maps on the geology of North America including Greenland, the West Indies, as well as the State of Hawaii, Guam, and other island possessions of the United States. Articles of a general nature by North American authors are cited even though published in foreign journals, but those by foreign authors are included only if they appear in North American journals. Abstracts are prepared only of material that is believed to be generally available. Ordinarily abstracts are not published of material with small circulation (such as dissertations, open-file reports or memorandums) or of other papers presented orally at meetings.

The Abstracts is an additional reference tool but does not replace the Bibliography of North American Geology, which has been published by the Geological Survey since 1887. Twelve monthly issues of Abstracts of North American Geology are published each year. The Bibliography includes citations and subject index for a calendar year.

The numbers assigned to the abstracts in this publication are for reference in using the index; they are not order numbers. Publications cited here in abstract form are available in most geological libraries or through interlibrary loan.

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A list of journals commonly cited in Abstracts of North American Geology may be obtained by writing to the U.S. Geological Survey, Washington, D. C. 20242.

The abstracts in this issue were prepared by W. L. Adkison, Harold H. Arndt, Henry C. Berg, R. C. Bostrom, Virginia P. Byers, R. A. Cadigan, H. E. Clifton, Georgianna D. Conant, Howard R. Cramer, Michael Fleischer, J. P. Ford, Andrew Griscom, B. R. Haley, P. T. Hayes, Virginia M. Jussen, A. R. Kinkle, Jr., R. A. Loney, Elisabeth S. Loud, Mildred C. Mead, Willis H. Nelson, Virginia S. Neuschel, C. L. Pillmore, Charles A. Sandberg, Katherine A. Sommer, Martha S. Toulmin, H. A. Tourtelot, and Dorothy B. Vitaliano.

ABSTRACTS

Abi-Chedid, Eddy. *See* Harton, James H. 07038

Adam, Eleanor K. *See* Guilday, John E. 07022

01364 **Adams, John W.; Fish, George E., Jr.** Thorium and rare-earth metals, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 430–435, illus., tables, 1968.

No commercial deposits of these minerals currently exist, but they are known to occur in North Carolina primarily. They are found as placer deposits or as accessory minerals in granitic rocks, chiefly in small grains of monazite.—HRC

07039 **Adamson, Lucas G.; Rieke, Herman H., 3d; Grey, Richard R.; Chilingar, George V.** Electrochemical treatment of highly shrinking soils: Eng. Geology—Internat. Jour., v. 2, no. 3, p. 197–203, illus., tables, 1967.

Fourteen samples from Menlo Park, Calif. (mainly rock flour) and Conejo Valley, near Ventura, Calif. (illitic soil) were treated electrochemically in the laboratory. Equipment and procedure used are described. Electrolyte solutions of calcium chloride, aluminum sulfate, aluminum acetate, and aluminum silicate were used in the experiments. X-ray diffractograms were prepared of samples from Menlo Park, before and after treatment, in order to detect any change in soil mineralogy due to treatment. Results showed that shrinkage of soils rich in clay minerals may be reduced considerably upon treatment, but, for rock flour (quartz, feldspar, etc. of clay size) the improvement may be insignificant.—*from* Authors' summary

06998 **Agassiz, Louis; Carozzi, Albert V.** (translator and editor). Studies on glaciers preceded by the *Discourse of Neuchatel*: New York and London, Hafner Publishing Co., 213 p., illus., 1967.

The editor's introduction traces the history of the concept of an ice age, and the controversy accompanying it. The 18 chapters of the *Studies* cover: historical review of the study of glaciers, generalities on glaciers, their structure, external aspect, color, crevasses, ice pinnacles, moraines, ice tables, gravel cones of glaciers, their formation, movement, lower surface and cavities, action on their substratum, temperature of glaciers and their surrounding ground water and atmosphere, oscillations of glaciers during historical time, former extent in the Alps, and proofs of existence of large ice sheets outside the realm of the Alps. The text is annotated where it seemed to require explanation and comparison with modern glaciological concepts, and is accompanied by 18 plates showing glaciers in the Alps, the first 14 accompanied by transparent line sketches.—ESL

07073 **Ager, D. V.; Copper, P.; Dunlop, G. M.; Elliott, G. F.; Middlemiss, F. A.; Rowell, A. J.; Williams, A.; Wright, A. D.** Brachiopoda, Chap. 12 *in* The fossil record—A symposium with documentation: London, Geol. Soc. London, p. 397–421, illus., 1967.

The range of 41 families and 31 superfamilies from 11 orders in 3 classes is documented, and three range charts are included.—ESL

01424 **Albee, Howard F.** Geologic map of the Munger Mountain quadrangle, Teton and Lincoln Counties, Wyoming: U.S. Geol. Survey Geol. Quad. Map GQ-705, scale 1:24,000, section, text, 1968.

Principal mineral resources of the Munger Mountain quadrangle are: gravel, readily available along the Snake River; limestone, abundant and accessible from outcrops of Mission Canyon, Draney, and Peterson Limestones; road metal from outcrops of Nugget Sandstone; and phosphate rock from the Phosphoria Formation in the southwestern and southeastern sections.—MCM

01501 **Albers, J. P.** Topography of California: California Div. Mines and Geology Mineral Inf. Service, v. 21, no. 5, p. 76–77, illus., revised 1968; originally published 1966.

The article is reprinted from *Mineral Resources of California*, U.S. Cong., 89th, 2d sess., Comm. Interior and Insular Affairs, Comm. Print (California Div. Mines and Geology Bull. 191), p. 23–25, 1966, with photographic illustrations added.—ESL

Alder, B. *See* Oeschger, H. 06997

Aldrich, L. T. *See* Krogh, T. E. 01585

01406 **Alexandrov, Eugene A.** Excursion to the Sterling and Franklin area in the Highlands of New Jersey, Trip D *in* Guidebook to field excursions—New York State Geol. Assoc., 40th Ann. Mtg., Flushing, N. Y., 1968: Brockport, N. Y., State Univ. Coll., Dept. Geology, p. 101–115, illus., 1968.

A summary of the general geology of the area is followed by a road log of 143 miles from New York City which includes but one stop, at the mine in Franklin, N. J. A cursory description of the geology along the way is given.—HRC

06976 **Allaart, Jan H.** Basic and intermediate igneous activity and its relationships to the evolution of the Julianehaab granite, South Greenland: Medd. om Grönland, v. 175, no. 1, 136 p., illus., tables, geol. maps, 1967; *reprinted as* Grönlands Geol. Undersögelse Bull. 69, 1967.

In the eastern part of this region, ENE-trending belts of gneiss and metamorphic supracrustals lie between large areas of six granite varieties. Much of the granite is probably anatectic pre-Ketilidian basement; three varieties belong to the 1st episode of Ketilidian plutonism, and three younger allochthonous varieties to basic and intermediate igneous activity of the second episode. Metadolerites appear to be intraorogenic; some hypersthene gabbros are contemporaneous with them. Slow consolidation of the allochthonous bodies permitted intrusion of basic dikes during formation of the Big-feldspar granite of the second phase which was marked also by migmatism in a southern belt of intrusives. The latest phase, eastward, is in leucocratic granite, remobilized older granites, and veined intrusions; tholeiitic dike swarms mark transition to cratogenic conditions.—GDC

07101 **Allan, D. W.; Thompson, W. B.; Weiss, N. O.** Convection in the Earth's mantle, *in* Mantles of the Earth and terrestrial planets (S. K. Runcorn, editor): London and New York, Interscience Publishers, p. 507–512, 1967.

A mathematical model of horizontal temperature gradient suggests that resultant free convection is probably more important as a mechanism in the mantle than forced convection caused by internal heat generation or heating from below.—JPF

Allen, William B. *See* Rosenshein, J. S. 01489

06995 **Allison, Stephen V.** Cost, precision, and value relationships of data collection and design activities in water development planning: California Univ. Water Resources Center Contr. 120 (Tech. Rept. 6-27), 142 p., illus., tables, 1967.

A method of allocating available resources between activities in water development planning is proposed, which is based on relationship between cost of each activity and precision attained. The degree to which this precision affects attainment of

overall objectives of the planning program measures its value in each activity. Quantitative expression of cost–precision and value of precision relationships provides the basis for application of mathematical decision techniques. Concepts are applied to building a mathematical model of the ground–water reservoir in the south end of San Joaquin Valley, Calif. Precision of data which must be collected is independent of funds expended in its collection, but for the study as a whole the proposed conceptual framework is valid. Optimal programs of collecting and manipulating required data are defined, and applicability of mathematical decision techniques to solution of such problems is demonstrated.—ESL

Allmann, Rudolf. *See* Donnay, Gabrielle. 01574

Ames, H. T. *See* Traverse, A. 01651

Amstutz, G. C. *See* Zimmerman, R. A. 01452

07011 **Anderle, R. J.** Determination of the Earth's geoid by satellite observations, *in* Mantles of the Earth and terrestrial planets (S. K. Runcorn, editor): London and New York, Interscience Publishers, p. 151–162, illus., tables, 1967.

Differences in various published solutions for the geoid do not appear to be unreasonable in view of the effects of various parameters on the solution and of the effects of biases under conditions where data density is limited. The principal geoid features can be obtained on the bases of data from a small number of stations during a short period of time, provided that all of the significant parameters are considered in the solution. Recent solutions, based on the Doppler system, yield geoid undulations to an accuracy of about 20 m. No doubt accuracy to about 10 m will be obtained in the future.—*from* Author's summary

07010 **Anderson, D. L.; Phinney, R. A.** Early thermal history of the terrestrial planets, *in* Mantles of the Earth and terrestrial planets (S. K. Runcorn, editor): London and New York, Interscience Publishers, p. 113–126, illus., 1967.

The Earth and terrestrial planets are thought to have formed by accretion from a gas–dust protoplanetary cloud. Several models are discussed in which the role of gravitational energy is minimized and the adiabatic and solar contributions to initial temperatures are emphasized. Comparison of different models of Earth and Mars leads to the conclusion that, for a given starting surface temperature, there is a minimum–sized planet which will be able to begin melting its iron in the lifetime of the solar system.—JPF

01339 **Anderson, Edwin Joseph.** Paleoenvironments of the Coeymans Formation (Lower Devonian) of New York State [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 8, p. 3335B, 1968.

01686 **Anglin, F. M.; Manchee, E. B.** Discrimination of temporally overlapping seismic events: Nature, v. 218, no. 5143, p. 757–758, illus., tables, 1968.

Routine digital processing of seismic events recorded on analog magnetic tape at the Yellowknife seismic array in Canada is carried out in Ottawa with the aid of a computer. An event recently processed produced outputs (on four traces) which settled alternately on two sets of values. One set indicated an origin in the North Atlantic and the other an origin in northwestern China. A new output was programmed (as described here) which separated the two events clearly. The arrival times were quite accurately determinable. This method makes it possible to detect two events and determine their epicenters with some precision using only the data from one medium–aperture array.—DBV

Applegate, Shelton P. *See* Fierstine, Harry L. 01649

07018 **Arkansas Geological Commission.** Central Arkansas economic geology and petrology—Geol. Soc. America, Field Conf., Nov. 1967, Guidebook: Little Rock, Ark., Arkansas Geol. Comm., 28 p., illus., table, 1967.

The area of this guidebook is between Little Rock and Hot Springs, and includes the areas of Bauxite, Benton, and Magnet Cove. Stops are made showing Jackfork Sandstone (Pennsylvanian) with mineralized quartz veins, Cretaceous nepheline syenite intruding Paleozoic formations, Saline bauxite and Chamberlain Creek barite deposits, the Potash Sulfur Springs intrusive and associated vanadium deposits in the Mazarn Basin, West Mountain overlook in Hot Springs National Park, and the Magnet Cover alkalic igneous complex with many varieties of rocks and associated minerals. Papers by B. J. Scull, and by J. S. Hollingsworth are cited separately. Illustrations include geologic sketch maps of several areas visited.—GDC

07001 **Armstrong, Augustus K.** Biostratigraphy and carbonate facies of the Mississippian Arroyo Penasco Formation, north-central New Mexico: New Mexico Bur. Mines and Mineral Resources Mem. 20, 81 p., illus., tables, 1967.

Cropping out in seven mountain areas of north-central New Mexico, the Arroyo Penasco Formation, 10 to 130 feet thick, rests on a peneplained Precambrian surface and is overlain unconformably by Pennsylvanian sedimentary rocks; its transgressive basal unit is quartz conglomerate, sandstone, and thin shale. Three carbonate cycles are recognized: dolomite, dedolomite, and poikilotopic calcite with a Late Osage microfauna in chert nodules; shallow-marine to intertidal mudstone and dolomite with sparse endothyran fauna of Early Meramec age; shallow-marine oolitic, richly microfaunal mudstone to intertidal dolomite, of Early to Middle Meramec age. Twenty measured type sections show distribution of fauna and lithofacies; seven species of *Endothyra* are described; and photomicrographs with explanations include other microfauna. Extensive erosion produced the solution collapse breccia of Lower Meramec rocks.—GDC

Arnal, Robert E. *See* Bandy, Orville L. 01322

01396 **Arndt, Harold H.; Averitt, Paul; Dowd, James; Frendzel, Donald J.; Gallo, Phillip A.** Coal, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 102–133, illus., tables, 1968.

A cursory description of the occurrence of both bituminous and anthracite coal in Appalachia is presented. A portion is devoted to the origin of coal, the coal industry, and the stratigraphy of the coal beds. No new information is included, however.—HRC

Aten, R. E. *See* Papadopulos, I. S. 01631

Atwood, Donald K. *See* Bubb, John N. 01230

Averitt, Paul. *See* Arndt, Harold H. 01396

01321 **Baars, Donald L.** Nature of calcification in codiacean algae [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 518, 1968.

Back, William. *See* Hanshaw, Bruce B. 07052

07032 **Bain, Roger J.** Paleoecology of some Leonardian patch reefs in the Glass Mountains, Texas: Brigham Young Univ. Geology Studies, v. 14, p. 195–236, illus., 1967.

A detailed examination of the reefs in an area 800 by 2,200 feet showed several reef-associated and lithologic facies. They developed on an extensive shelf which, with subsidence, resulted in shelfward migration of the environments, passing over a dolomitic limestone and arriving in the area during Hess time. Patch reefs, constructed in 30–35 feet of water, produced a protected shelf environment with a distinctive fauna. Later subsidence resulted in the clastic Cathedral Mountain Formation being deposited over the area, when sponges appeared. With decreased subsidence, reef barriers formed on the shelf here, and bryozoa and algal reefs developed in about 60 feet of water. Various sedimentary environments with associated fauna are described.—*from* Author's abstract

Ballard, L. N. *See* Powell, H. E. 01512

06956 **Bandel, Klaus.** Trace fossils from two Upper Pennsylvanian sandstones in Kansas: Kansas Univ. Paleont. Contr.—Paper 18, 13 p., illus., 1967.

Trails and burrows from two sandstones [in Rock Lake Shale and Vinton Shale] of the Upper Pennsylvanian of Douglas County, Kansas, are described and interpreted. Some of these are known from the literature, others are new. The trace fossil fauna suggests deposition of the sandstones in littoral shallow water. Although shelly fossils in both units are similar, the differences in the two trace-fossil faunas which have only two species in common indicate presence of two different environments.—Author's abstract

06957 **Bandel, Klaus.** Isopod and limulid marks and trails in Tonganoxie Sandstone (Upper Pennsylvanian) of Kansas: Kansas Univ. Paleont. Contr.—Paper 19, 10 p., illus., 1967.

Tracks and trails have not been described previously from Pennsylvanian rocks of Kansas, although they occur abundantly in almost every sandstone of this area examined by the author. Discovery of fossil animal remains of any kind in the Tonganoxie Sandstone Member is important because the paleoenvironment of this unit is not well understood. Tracks and trails found in considerable numbers in the basal part of the Tonganoxie are here interpreted as of isopod and limulid origin. Both arthopods are rare as fossils and not known from the Pennsylvanian of Kansas. No trails or tracks of other origin could be recognized. A comparison with Recent environments of limulids and isopods supports interpretation of the Tonganoxie as probably estuarine in origin.—*from* Author's abstract

01322 **Bandy, Orville L.; Arnal, Robert E.** Middle Tertiary planktonic foraminiferal facies, San Joaquin basin, California [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 518–519, 1968.

07070 **Banks, H. P.; Chaloner, W. G.; Lacey, W. S.; Collett, M. G.; Gnauck, F. R.; Hughes, N. F.** Pteridophyta, Chaps. 4–5 *in* The fossil record—A symposium with documentation: London, Geol. Soc. London, p. 219–245, illus., 1967.

Chapter 4 records the microphyllous pteridophytes, for which the range of 31 families and 4 orders from 3 classes are documented; chapter 5 covers the ferns. *Archaeopteris* and *Callixylon* are included under Progymnospermopsida in Chapter 6 (not cited), but the Stauropteridaceae have been retained here. The range of 29 families, 12 subfamilies, and 4 genera in 8 orders are documented and charts showing the ranges are included in both chapters.—ESL

07074 **Banner, F. T.; Clarke, W. J.; Cutbill, J. L.; Eames, F. E.; Lloyd, A. J.; Riedel, W. R.; Smout, A. H.** Protozoa, Chap. 8 *in* The fossil record—A symposium with documentation: London, Geol. Soc. London, p. 291–332, illus., 1967.

The range of over 1,000 families, 8 subfamilies, 2 superfamilies, and 2 orders in 3 classes of Protozoa is documented. The larger Foraminifera, except fusulinids, have 108 genera and some subgenera recorded from 13 families. Six range charts are included.—ESL

01323 **Barber, Thomas D.** Geology of Shelder field, Dimwitt [!sic] County, Texas [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 519, 1968.

01619 **Barla, G.; Wane, M. T.** Analysis of the borehole stress-relief method in rocks with rheological properties: Internat. Jour. Rock Mechanics and Mining Sci., v. 5, no. 2, p. 187–193, 1968.

Under the assumption that rock behaves as a linear, homogeneous, isotropic viscoelastic substance, an analysis of the borehole stress-relief method is formulated. Small strains and displacement theory is used in considering the instantaneous elastic and subsequent viscoelastic radial displacements which occur in a borehole after drilling and overcoring. Formulae are written which allow one to determine the principal stresses at a point inside a rock mass from measurements taken after

overcoring. However, the lack of experimental data does not yet permit the estimation of the discrepancy in the values of the principal stresses obtained by taking into account only the instantaneous elastic displacements.—Authors' abstract

07113 **Barnes, H. L.** Sphalerite solubility in ore solutions of the Illinois–Wisconsin district, *in* Genesis of stratiform lead–zinc–barite–fluorite deposits (Mississippi Valley type deposits)—A symposium, New York, 1966: Econ. Geology Mon. 3, p. 326–332, illus., 1967.

It is shown that the only mechanism of hydrothermal transport of sphalerite known to be compatible with geologic restriction in this district is bisulfide complexing.—VSN

01490 **Barnes, Ivan; Bentall, Ray.** Water–mineral relations of Quaternary deposits in the lower Platte River drainage area in eastern Nebraska: U.S. Geol. Survey Water-Supply Paper 1859–D, p. D1–D39, illus., tables, 1968.

In the Platte River area sand is dominant in sediments beneath the loess of the terrace plain, with gravel at greater depths. Under the river valley, gravel is common at all depths and sand is coarser. Light minerals, mostly quartz, constitute 95 percent of the sediments. Soils are permeable and readily absorb precipitation, and recharge takes place from the rivers. Water from wells on the terrace plain was undersaturated with respect to calcite, as it is so uncommon in the deposits, but the partial pressure of CO_2 was 30 to 90 times greater than in the atmosphere, probably due to solution from loess. River water differs from that of the Lincoln City well field in that it is about ten times supersaturated with respect to calcite, contains less dissolved CO_2, and has a higher pH. There may be a smaller fraction of river water in these wells than thought. Nine test hole logs are included.—ESL

01677 **Barosh, Patrick J.** Correlation of Permian and Pennsylvanian sections between Egan Range and Spring Mountains, Nevada: U.S. Geol. Survey Bull. 1254–I, p. I1–I8, illus., 1968.

The Permian and Pennsylvanian parts of the Bird Spring Formation near Lee Canyon in the northern Spring Mountains, northwest of Las Vegas, can be correlated with the Ely Limestone, lower and coralline members of the Riepe Spring Limestone of Steele (1960), the Rib Hill Sandstone, and the lower member of the Arcturus Formation of the central Egan Range, near Ely, on the basis of similarities in lithology, sequence, and assigned age. The thick Lee Canyon sequence is a key section in the correlation of the Permian and Pennsylvanian strata of east–central and southern Nevada.—Author's abstract

Barr, Jim L. *See* Pryor, Wayne A. 01187

01516 **Barr, W.; Barrett, Paul E.; Hussell, D. J. T.; King, Roger H.; Koerner, R. M.** Devon Island programs, 1967: Arctic, v. 21, no. 1, p. 44–50, 1968.

The Arctic Institute's facilities on Devon Island, Northwest Territories, were used during the summer of 1967 for further studies in glaciology, glacio–isostatic geomorphology, periglacial geomorphology, ornithology, and botany. Mass balance of the ice cap was measured; study of raised marine features of the northeast coast was extended to Cape Parker. Seaweed interbedded with sand in eroded bluffs, collected for dating, may throw light on paleoecology; evidences of west–east tilt and eastern submergence are cited. Detailed study of periglacial features in an extended area on the north coast included micrometeorological and comparative pedological studies in the Truelove Valley.—GDC

Barrett, Paul E. *See* Barr, W. 01516

01324 **Barss, D. L.; Copland, A. B.; Ritchie, W. D.** Geology of Middle Devonian reefs, Rainbow area, Alberta, Canada [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 519, 1968.

01444 **Bates, Robert L.** Editorial to—The supply and demand of geologists (by M. T. Halbouty, 1968): GeoScience News, v. 1, no. 4, p. 14–15, 1968.

The writer has been asked to comment on part of the article (ibid., p. 12–14), that deals with the attitude of the graduate student toward oil-company employment. Some answers are given as to why graduates are not liking what they see in the oil industry, and turning elsewhere. The policy of multiple layoffs by management is a big factor; a second is the dramatic upturn in employment in college and university teaching.—ESL

01684 **Bauer, A.** Le glacier de l'Eqe (Eqip sermia) mouvement et variations du front (1959) [with English abs.]: Medd. om Grönland, v. 174, no. 2, 21 p., illus., tables, 1968.

The position of the front and the flow of the Eqe glacier was determined in July 1959; the accuracy of the geodetic measurements is evaluated. The successive positions of the front from 1912 to 1964 show growth of the glacier to about 1920, and retreat since then.—*from* Author's abstract

07080 **Baxter, Robert W.** *Verticillaphyton paradoxum*, a problematical fossil genus of Pennsylvanian age from Iowa coal balls: Kansas Acad. Sci. Trans., v. 70, no. 1, p. 71–76, illus., 1967.

A new genus of unknown affinities is described on the basis of a small, fragmentary plant axis around 1 cm in length with many unique characteristics. The specimen comes from the Middle Pennsylvanian rocks in the Mich mine at Oskaloosa, Iowa.—HRC

01362 **Bay, Roger Rudolph.** Interpretation of fundamental hydrologic relationships of forested bogs in northern Minnesota [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 8, p. 3364B, 1968.

07059 **Beaver, H. H.** (and others). Treatise on invertebrate paleontology—Pt. S, Echinodermata 1, General characters, Homalozoa, Crinozoa (except Crinoidea), V. 1–2: New York, Geol. Soc. America (and Univ. Kansas Press), V. 1, p. S1–S296, illus., tables, 1967; V. 2, p. S297–S650, illus., table, 1967.

General characters of living and fossil echinoderms are compared as to morphology, ontogeny, physiology, and phylogeny. Ontogeny of living forms, as related to phylogeny, is treated in detail. Taxonomy of subphyla Homalozoa and Crinozoa is treated (except Crinoidea, Pt. T), with systematic descriptions to the generic level; these taxa were all extinct by the end of the Permian, and their classification is difficult. Cited separately are: six crinozoan classes—cystoids, paracrinoids, edrioblastoids, parablastoids, blastoids, eocrinoids; three homalozoan classes (carpoids)—stylophorans, homosteles, homoiosteles; as addenda, camptostromatoids, a new echinozoan class, lepidocystoids, a new crinozoan class, and two unclassified echinoderm genera. Senior authors of the sections are: G. Ubaghs, H. B. Fell, R. V. Kesling, R. O. Fay, H. H. Beaver, K. E. Caster, J. W. Durham.—VMJ

07125 **Beaver, Harold H.; Fay, Robert O.; Macurda, Donald B., Jr.; Moore, Raymond C.; Wanner, Johannes.** Blastoids, *in* Treatise on invertebrate paleontology—Pt. S, Echinodermata 1, V. 2: New York, Geol. Soc. America (and Univ. Kansas Press), p. S297–S455, illus., tables, 1967.

The crinozoan class Blastoidea Say, 1825, comprises about 78 genera and 350 species in 12 families, five in the order Fissiculata and seven in Spiriculata; world-wide, they range from Silurian through Permian, reaching a maximum in the Mississippian. Blastoids have a pyriform to globular pentaradiate theca or calyx, a short column, and five linear or petaloid ambulacra which bear numerous threadlike brachioles projecting upward. The regular arrangement of thecal plates and the characteristic hydrospire structures (water-vascular system) provide the basis for classification within Blastoidea, as well as distinction from cystoids, parablastoids, and coronate crinoids. Blastoids are possibly descended from edrioblastoids. Morphology, study techniques, ontogeny, hydrodynamics, paleoecology, classification systems, and phylogeny are discussed.—VMJ

Becher, Albert E. *See* Meisler, Harold. 01644

Beeson, Marvin H. *See* Gordon, Glen E. 01513

Béland, J. *See* Lajoie, J. 01468

Bell, P. M. *See* Richardson, S. W. 01548

Bell, P. M. *See* Kullerud, G. 01563

Bell, P. M. *See* Meyer, H. O. A. 01589

01590 **Bell, P. M.; England, J. L.; Boyd, F. R.** Pressure effect on the platinum versus platinum ten percent rhodium thermocouple: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 545–547, illus., 1968.

In high-pressure, high-temperature experiments, the thermocouple must be subjected to pressure also. Since thermoelectric behavior is affected by pressure, questions have been raised as to the accuracy of this type of temperature measurement. A technique originally designed by Bridgman (1918) was used to determine absolute values for the effect of pressure on thermal emf of a platinum vs. platinum 10 percent rhodium thermocouple. Results of measurements made at 20°, 185°, 305°, and 509°C at various pressures are plotted. The apparatus is capable of achieving 13 kb at about 900°C. Trends established show that the pressure effect is very significant.—ESL

01658 **Bell, R. T.** Proterozoic stratigraphy of northeastern British Columbia: Canada Geol. Survey Paper 67–68, 75 p., illus., tables, 1968.

Proterozoic rocks of northeastern British Columbia are divisible into three successions. The lower and oldest, of probable Helikian age and consisting dominantly of quartzites and carbonate rocks, is at least 11,000 feet thick and is divided into the Chischa, Tetsa, George, Henry Creek and Tuchodi Formations. The middle succession, also of probable Helikian age, consists of at least 8,000 feet of shaly flysch and is divided into the Aida and Gataga Formations. The uppermost succession of phyllites, slates, and greenstone is 5,000 feet thick and is probably of Hadrynian age but may be as young as Early Cambrian. The Gataga Formation and older units are cut by diabase dikes and underwent gentle deformation in the Late Proterozoic. [Appendix contains 16 measured sections.]—Author's abstract

01337 **Benak, Joseph Vincent.** Engineering properties of the Late Pleistocene loess in the Omaha–Council Bluffs area [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 8, p. 3270-B, 1968.

Bentall, Ray. *See* Barnes, Ivan. 01490

Berg, Joseph W., Jr. *See* Hutt, Jeremy R. 01504

01379 **Bergendahl, M. H.; Stansfield, Robert F.** Gold, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 385–396, illus., tables, 1968.

A very short description of the origin and occurrence of gold in Appalachia is given, although none is currently being sought. It occurs as placers, in the saprolite, and in quartz veins in the Piedmont; most production has come from Georgia, Alabama, and North Carolina.—HRC

01319 **Berger, Wolfgang H.** Selective solution in planktonic Foraminifera—Liability and asset in reconstruction of ancient environments [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 520, 1968.

Berner, Robert A. *See* Clayton, Robert N. 01524

Bernhagen, Ralph J. *See* Calvert, Warren L. 01334

Biggs, Charles A. *See* McGregor, A. A. 01178

01615 **Birch, Francis.** On the possibility of large changes in the Earth's volume: Physics Earth and Planetary Interiors, v. 1, no. 3, p. 141–147, illus., 1968.

In the light of experiments reaching core pressures, Ramsey's hypothesis that the core is a high-density form of mantle material is not tenable. For the "real Earth" having chemically distinct mantle and core, the increase of radius for a decrease of the gravitational constant from 2G to its present value G is about 370 km; this is a greater change of G than is allowed by other considerations. It appears that so long as the Earth has had its present mass, changes of external radius are limited to amounts of the order of 100 km.—*from* Author's abstract

01640 **Bird, Samuel O.** A pelecypod fauna from the Gaptank Formation (Pennsylvanian), west Texas: Bulls. Am. Paleontology, v. 54, no. 240, p. 111–185, illus., tables, 1968.

The richest fossiliferous zone of the Gaptank Formation is Bed 10 for which a Missourian age is indicated. The fauna includes nine new species, some so unique that they do not compare well with any known species. Open nomenclature is therefore used. The fauna belongs to the *Chonetina* association, a normal marine assemblage, and the association with gastropods and brachiopods indicates a deep water environment. The deep water may account for the uncommon diversity of the pelecypods.—*from* Author's abstract

01317 **Bissell, H. J.** Shelf-to-basin Lower Triassic sediments across Las Vegas hingeline, Nevada [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 520–521, 1968.

01526 **Blackadar, R. G.; Davison, W. L.; Trettin, H. P.** Geology, Navy Board Inlet, District of Franklin: Canada Geol. Survey Map 1236A (provisional edition), scale 1:253,440, text, 1968.

The highest point, 4,200 feet, in the Navy Board Inlet region of the Lancaster Plateau, Baffin Island, is the summit of the icecap east of Elwin Inlet. Precambrian strata include Aphebian granitic and gneissic rocks, and Nauyat, Adams Sound, Arctic Bay, Society Cliffs, Victor Bay, Strathcona Sound, and Elwin Formations; these are overlain by Cambrian Gallery Formation, Cambrian and/or Ordovician Turner Cliffs Formation, and Ordovician Ship Point and Baillarge Formations. On the north coast of Borden Peninsula a belt of lower Paleozoic strata dip gently north, probably forming an extension of the arcuate, southwesterly to northwesterly dipping Brodeur homocline; in the remaining parts of the area, they rest nearly horizontally.—MCM

01527 **Blackadar, R. G.; Davison, W. L.; Trettin, H. P.** Geology, Phillips Creek, District of Franklin: Canada Geol. Survey Map 1239A (provisional edition), scale 1:253,440, text, 1968.

Precambrian rocks in the Phillips Creek area are limited to gneissic rocks of Aphebian age and gabbro dikes of presumed Neohelikian age; lower Paleozoic strata rest with pronounced unconformity on the Aphebian rocks. Paleozoic rocks include the Cambrian Admiralty Group, Ordovician Ship Point Formation, and Ordovician and Silurian Baillarge Formation. Paleozoic strata are nearly horizontal, but locally are disturbed by several fault zones, the most important being a group of southeasterly striking normal faults that mark the northeastern boundary of the Paleozoic outcrop area. Drainage is partly rectilinear and is controlled, to some extent, by a complicated pattern of bedrock fractures that affect bedrock as old as Precambrian as well as unconsolidated Holocene sediments.—MCM

01607 **Blackadar, R. G.; Davison, W. L.; Trettin, H. P.** Geology, Milne Inlet, District of Franklin: Canada Geol. Survey Map 1235A (provisional edition), scale 1:253,440, text, 1968.

The Milne Inlet area, part of Lancaster Plateau on Baffin Island, has elevations over 3,200 feet in the north, decreasing southward to about 1,000 feet. Precambrian-

Silurian formations, first described by Lemon and Blackadar (1963), are summarized. Paleozoic strata, confined to the northeastern and southern parts of the area where they rest unconformably on Precambrian rocks, are generally horizontal, but locally disturbed by southeasterly trending normal faults which in parts of the area form the boundary between the Paleozoic and Precambrian outcrop areas. It seems that some of these faults formed before the deposition of the Paleozoic strata and were reactivated in post-Silurian time.—MCM

Blaine, L. R. *See* Hovis, W. A., Jr. 01680

07037 **Blesch, Robert R.** Mapa geomorfológico, República Dominicana: Washington, D.C., Organización de los Estados Americanos, scale 1:500,000, 1967.

Bolli, H. M. *See* Kugler, H. G. 06996

01360 **Bollinger, Gilbert Arthur.** Determination of earthquake fault parameters from long period P waves [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 8, p. 3347B-3348B, 1968.

01522 **Bostrom, R. C.; Couch, R. W.; Rasmussen, N. H.; Sherif, M.** An observation program on level changes and the incidence of seismicity in the Puget Sound area: Trend Eng., v. 20, no. 2, p. 18-20, illus., 1968.

Change in ground level is a phenomenon associated with accumulation of elastic strain and subsequent occurrence of earthquakes. To detect level changes, the University of Washington has initiated a program to observe differences in value of g between benchmarks once a year or oftener, repeat readings to be made at identical tide phases. Present gravimeters detect level changes of 3 cm; with generation of high-accuracy meters it is hoped to improve accuracy by an order of magnitude. Comparison of old and new level surveys suggests warping is taking place locally at rates up to 1 cm per yr, and seismicity is most intense where rate of level change varies most rapidly in a horizontal direction. In seismic regions re-observation of point-to-point differences in g seems to offer a practical method of monitoring accumulation of strain; in coastal regions observations would permit separation of land uplift from eustatic changes in sea level.—RCB

01523 **Bostrom, R. C.** Oceanward spreading of the continental crust in the fjord region of northwest America: Trend Eng., v. 20, no. 2, p. 4-9, 32, illus., 1968.

Studies aimed at understanding the state of crustal stress in the fjord region of northwestern America suggest that, in addition to Quaternary glacial sculpturing, the continental crust in British Columbia is subject to relaxational spread toward the Pacific Ocean basin under action of gravity. Sequence of events is: (1) 5.5 m.y. ago principal crest of the East Pacific Rise shifted beneath the continent's western margin, concomitant with decline of activity on Juan de Fuca Ridge and development of onshore Quaternary vulcanism; (2) influence of the Rise has been responsible for uplift and weakening of continental crust; (3) strain dissipation is taking form of oceanward spreading; (4) spread rate increased during Quaternary glacial loading; and (5) landforms and tectonic lineaments of coastal areas are an expression of subglacial deformation and failure.—*from* Author's abstract

01510 **Boswell, E. H.; Cushing, E. M.** Water resources of the Mississippi embayment east of the Mississippi River: Soc. Mining Engineers Trans., v. 241, no. 2, p. 137-148, illus., 1968.

The embayment east of the River is part of a vast geologic and hydrologic province, and the multiple artesian aquifer systems that underlie the region and the alluvial aquifer along the Mississippi River are virtually undeveloped sources of fresh water. The potential yield of the 12 aquifer systems is estimated to be about 25,000 mgd of which only about 600 mgd is presently being withdrawn. The amount of water in storage in these systems is about 1,600 trillion gal. Ground water having a dissolved-solids content of less than 500 ppm is generally available at depths of less than 1,000 feet. Iron is the most common troublesome chemical constituent. Water in varying amounts is also available from streams within the region. [A

geologic sketch map and sections, and maps of each aquifer showing configuration of the base are included.]—*from* Authors' abstract

01318 **Bourn, Oscar B.** An application of Upper Pennsylvanian palynological data to interpret environment of deposition [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 521, 1968.

Bowman, Richard S. *See* Calvert, Warren L. 01334

01536 **Boyd, F. R.** Quantitative electron-probe analysis of pyroxenes: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 327–334, tables, 1968.

An accuracy of 1–2 percent of the amount of an element present in an unknown can be achieved in electron-probe analysis if standards are selected so that the absorption correction is kept below about 10 percent. Analyses for 10 elements have been made for some diopsidic pyroxenes from kimberlite nodules. These pyroxenes show a much wider range of solid solution with enstatite than do those from other geologic environments. Comparison with the solvus in the pure system $CaMgSi_2O_6$–$MgSiO_3$ indicates a range of equilibration temperatures for these pyroxenes of about 900°–1300°C. Thus they appear to have come from a considerable range of depth in the upper mantle.—MST

01540 **Boyd, F. R.; Brown, G. M.** Electron-probe study of exsolution in pyroxenes: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 353–359, illus., 1968.

Calcium-rich and calcium-poor pyroxenes occurring together in terrestrial and meteoritic rocks are of interest since their contrasted compositions are related to the temperatures and pressures of crystallization. Assemblages from the Bushveld, Skaergaard, and Stillwater intrusions were studied. All coexisting pyroxenes contained exsolution lamellae of another pyroxene phase. Qualitative scans were made across four orthopyroxene grains showing a variety of exsolution textures.—ESL

Boyd, F. R. *See* Bell, P. M. 01590

Boyer, Robert E. *See* Edge, Lyle N. 01447

01518 **Bradbury, J. C.; Finger, G. C.; Major, R. L.** Fluorspar in Illinois: Illinois Geol. Survey Circ. 420, 64 p., illus., tables, 1968.

Fluorspar deposits, found in Hardin and Pope Counties of extreme southeastern Illinois, occur as fissure fillings in faults and replacement bodies in limestone. Practically all of the production comes from underground mines. Lead and zinc concentrates are important coproducts of beneficiation. For many years Illinois has been the leading producer of fluorspar in the United States, but foreign competition has curtailed growth of the domestic industry. Part 1, written by Bradbury, contains a brief, semitechnical account of the geology; part 2, by Major, concerns the economic aspects; and part 3, by Finger, discusses uses of fluorspar and fluorine chemicals.—GDC

01618 **Brant, Arthur A.** The pre-evaluation of the possible profitability of exploration prospects [with German abs.]: Mineralium Deposita, v. 3, no. 1, p. 1–17, illus., tables, 1968.

The need for exploration and discovery is apparent from doubling of the tonnage mined about each 12 years. The dependency of exploration expenditure on profits and cash flow is indicated; capital outlays for selected U.S. and Canadian mines are listed. The increasing exploration risk, i.e., money spent per discovery, necessitates that criteria be evolved to evaluate exploration projects on the basis of their profitability potential. This involves the chance of occurrence, of actual discovery, and of sufficient economic value. These factors are discussed and their evaluation outlined. An operational equation is set up, and the return on an exploration venture, and a series of exploration ventures, versus the odds against involved, are presented as a possible means of pre-evaluating exploration projects.—Author's abstract

01320 **Bretsky, Peter W.** Bryozoan ecology and sedimentary environments in central Appalachian Upper Ordovician [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 521, 1968.

Breuer, Joseph W. *See* Huff, Warren D. 01222

01229 **Briggs, Louis I.; Zigic-Toshich, Darinka.** Digital simulation models of evaporite sedimentation [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 521-522, 1968.

Briggs, Louis I. *See* Zigic-Toshich, Darinka. 01413

01669 **Bright, E. G.** Halliday township, District of Sudbury: Ontario Dept. Mines Prelim. Geol. Map P. 385, scale 1 in. to 1/4 mi., text, 1967; revised 1968.

Precambrian metasediments, mainly conglomerate, greywacke, arkose and slate with subordinate lenses of marcasite-graphite schist, form an E-W trending belt, crossing northern Midlothian township and extending westward into Halliday township. These are overlain unconformably by similar younger, probably Huronian, metasediments. The belt of older metasediments occupies the central portion of a large easterly-plunging syncline whose axis had been displaced by a series of N-S shear zones; strong E-W faults cross both the townships. Gold (associated with chalcopyrite, galena, tetrahedrite, and sphalerite) and silver have been mined, and there are possibilities for nickel and asbestos.—MCM

01670 **Bright, E. G.** Midlothian township, District of Timiskaming: Ontario Dept. Mines Prelim. Geol. Map P. 386, scale 1 in. to 1/4 mi., text, 1967; revised 1968.

The text for the Halliday and Midlothian townships is abstracted for Map P. 386, Bright, 1968.—MCM

01520 **Bristol, H. M.; Prescott, Ronald.** Geology and oil production in the Tuscola area, Illinois: Illinois Geol. Survey Circ. 424, 34 p., illus., tables, 1968.

Tuscola anticline, in east-central Illinois, lies astride the LaSalle anticlinal belt and dips westward in the Fairfield basin and eastward into the Murdock syncline; it is broken into two structural highs, the Hayes and Shaw Domes. Pleistocene sediments are 50-250 feet thick; Pennsylvanian sediments cover much of the southwestern area, thinning to expose an inlier of Mississippian, Devonian, and Silurian rock north of Tuscola. Mt. Simon Sandstone, basal Cambrian, is penetrated by only two wells. Oil production from the Kimmswick (Trenton) commenced in 1962; as of January 1, 1968, approximately 30 wells were producing oil, cumulative production being about 94,000 bbl; potential pay zone is confined to the upper 50-100 feet of structure and to the upper 125 feet of the Kimmswick. Oil and gas production from the Fairfield basin portion is from Spar Mtn. Sandstone.—*from* Authors' abstract

01390 **Brobst, Donald A.; Hobbs, Robert G.** Barite, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 270-277, illus., tables, 1968.

A very brief description of the origin and occurrence of barite in Appalachia is given. Most of the data are in tables. Georgia is the largest producer, although small amounts occur in many other places.—HRC

Broecker, Wallace S. *See* Ku, Teh-Lung. 01606

07076 **Brookins, Douglas G.** New meteorite find from McPherson County, Kansas: Kansas Acad. Sci. Trans., v. 70, no. 2, p. 268, 1967.

A 16-pound olivine hypersthene chondrite, found in a field near Inman, Kansas, is named the Inman meteorite.—HRC

07079 **Brookins, Douglas G.** The chemical composition of calcite from the Kimzey Quarry carbonatite, Magnet Cove, Arkansas: Kansas Acad. Sci. Trans., v. 70, no. 1, p. 140–141, table, 1967.

Calcite from Kimzey Quarry carbonatite was analyzed for bulk chemical composition and for strontium isotope composition. The analyses are compared with those of other carbonatites and carbonate rocks. The average sedimentary carbonate rock is characterized by a higher SiO_2, CO_2, FeO, MgO, and H_2O content, and a lower of CaO, SrO, P_2O_5 content than the carbonatites. The difference in strontium isotope composition between the Kimzey Quarry carbonatite and the average sedimentary carbonate is very striking.—HRC

07088 **Brooks, H. K.; Pirkle, E. C.; Fountain, R. C.** Road log, *in* Miocene and Pliocene problems of peninsula Florida—Southeastern Geol. Soc., 13th Field Trip 1967 [guidebook]: Tallahassee, Fla., Southeastern Geol. Soc., p. 18–43, tables, 1967.

The road log contains essential comments and data on correlation and environment for each stop, and a measured stratigraphic section.—ESL

Brooks, H. K. *See* Southeastern Geological Society. 07096

01594 **Brooks, R. R.; Presley, B. J.; Kaplan, I. R.** Trace elements in the interstitial waters of marine sediments: Geochim. et Cosmochim. Acta, v. 32, no. 4, p. 397–414, illus., tables, 1968.

Phosphate and 11 elements were determined in the interstitial waters of four piston cores from the continental borderland area off the coast of southern California. Ca, Mg, K, Na, and Sr were determined directly by extraction of the chelate complexes and analysis by atomic absorption spectrophotometry. Correlation coefficients for various pairs of variables are given. Reducing sediments display the following characteristics: (1) with increase of depth, the dissolved phosphate concentration increased by several orders of magnitude and the Ca concentration decreased by more than 50 percent; (2) Fe and Ni become solubilized. Enrichment of Zn, Cd, Cu, and Co at the surface of the sediments is attributed to organic debris.—KAS

01598 **Broughton, Paul L.** Cave formations: Frontiers, v. 32, no. 5, p. 4–7, illus., 1968.

Once the passage networks of a cave have been formed, deposition of speleothems begins. Water dissolves calcium carbonate from the limestone above the cave and deposits it as droplets fall from the ceiling or run down the wall. Stalactites and stalagmites grow about a hundredth of an inch a year. Other forms described and pictured are flowstone, helictites, soda straws, cave grapes and pearls, and gypsum needles. Nearly 150 caverns such as Carlsbad Caverns and Mammoth Cave have been developed commercially. A plea is made for conservation of cave formations.—ESL

Broussard, W. L. *See* Winner, M. D., Jr. 01625

Brown, Daniel M. *See* Isaacs, John D. 01438

01538 **Brown, G. M.** Experimental studies on inversion relations in natural pigeonitic pyroxenes: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 347–353, illus., table, 1968.

The relations between subsolidus exsolution and inversion in pigeonite, clinohypersthene, and rhombic hypersthene have been studied at 2–20 kb pressures and at zero pressure in the presence of andesitic liquid. For hypersthene at zero pressure, the rhombic⇌monoclinic inversion took place at about 990°C. Solution of augite in clinohypersthene and exsolution from pigeonite were seen to occur between 990°C and 1020°C at zero pressure. A proposed subdivision of Ca-poor pyroxenes takes into account both compositional differences and observations on natural inversion relations. Polymorphic mineral inversions and exsolution in the presence of magmatic fluxes appear to be much more rapid than in isolated crystals,

thus permitting studies relevant to the crystallization history of many igneous pyroxenes at the lower pressures.—MST

Brown, G. M. *See* Lindsley, D. H. 01539

Brown, G. M. *See* Boyd, F. R. 01540

Brown, G. M. *See* Naldrett, A. J. 01557

01568 **Brown, G. M.; Schairer, J. F.** Melting relations of some calcalkaline volcanic rocks: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 460–467, illus., tables, 1968.

Studies on suites of rocks from the West Indies and Solomons Island arcs were made to help explain unique chemical, mineralogical, and field relations. The arcs are sites of active and highly explosive volcanoes. The first step was to examine melting relations under dry conditions. Results are related to work previously reported on tholeiitic and alkalic suites and a calcalkaline suite from Parícutin. Some melting data obtained under a P_{water} of 2 kb are given. The influence of water was judged particularly significant in considering the physical conditions under which these calcalkaline magmas originated.—ESL

Brown, G. M. *See* Schairer, J. F. 01569

01681 **Browne, Ruth G.; Bruder, Pamela M.** Wisconsin molluscan faunas from Henderson County, Kentucky: Bulls. Am. Paleontology, v. 54, no. 241, p. 191–275, illus., tables, 1968.

Molluscs of Wisconsin age are described from nine localities bordering the Ohio River in western Kentucky. The area is covered by the Henderson, Smith Mills, and Wilson 7 1/2 minute quadrangles. The faunas, with a single exception, are from the Peoria loess. Molluscs were recovered from the Farmdale loess at one locality. Thirty-two species representing 12 families are covered by the study. Twenty-eight of these species are land gastropods. Of the remaining four, three are semiaquatic and one true aquatic. The general paleoenvironment is considered to have been a moist situation inhabited by species living in marsh and flood plain regions close to bodies of water. The area was forested or forest bordered and the climate was cool.—Authors' abstract

Bruder, Pamela M. *See* Browne, Ruth G. 01681

01638 **Brzezinski, L. S.** The performance of a timber crib founded on soft very sensitive lacustrine clay, *in* Canadian Soil Mechanics Conf., 20th, Papers, Pt. 1: Canadian Geotech. Jour., v. 5, no. 1, p. 1–15, illus., tables, 1968.

A paper mill and townsite were constructed on Lac Quevillon, Quebec, within the limits of glacial lake Barlow–Ojibway. A timber crib intake structure was located in about 12 feet of water and founded within soft to very soft lake bottom clay. Testing of the clay indicated a two-part consolidation curve, with the break occurring at a point about 400 lb per sq ft in excess of in situ overburden pressure. The crib was founded on a sand and gravel mattress, keyed into the lake bottom, the resulting net stress increase on the clay being slightly within the inferred range of apparent preconsolidation established by laboratory tests. Performance readings on the crib over a period of about a year after construction have substantiated the field existence of an apparent preconsolidation of about the order of magnitude predicted by laboratory tests.—ESL

01459 **Bubb, J. N.; Perry, Douglas.** Porosity in some synthetic dolomites: Jour. Sed. Petrology, v. 38, no. 1, p. 247–249, illus., table, 1968.

Porosity formed during laboratory dolomitization of large calcite crystals is in good agreement with the 13 percent theoretically expected by the idea of local-source dolomitization. The voids formed are irregular in size, shape, and distribution.—Authors' abstract

01230 **Bubb, John N.; Atwood, Donald K.** Recent dolomitization of Pleistocene limestones by hypersaline brines, Great Inagua Island, Bahamas [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 522, 1968.

Buckley, Jane T. *See* King, Cuchlaine A. M. 01473

06990 **Bullen, K. E.** Seismic and related evidence on the structure of the Earth's upper mantle [also Spanish text]: Geofísica Internac., v. 7, no. 2, p. 31–41, 1967.

A survey and related evidence on the density, incompressibility and rigidity in the outermost 1,000 km of the Earth are given. Earlier evidence, including reference to the writer's Earth models *A'*, *A* and *B*, is summarized with special reference to sources of uncertainty. Consideration is given to recent evidence from bodily and surface seismic waves, the recent reduction in the estimated moment of inertia of the Earth, and free Earth spheroidal and torsional oscillation data. Reference is made to current work of Bullen and Haddon which points to density gradients less than normal and to reduced *S* velocities in the upper mantle as well as to a larger radius for the core.—*from* Author's abstract

07099 **Bullen, K. E.** Models of the internal density in the Earth, Mars, and Venus, *in* Mantles of the Earth and terrestrial planets (S. K. Runcorn, editor): London and New York, Interscience Publishers, p. 127–138, tables, 1967.

Essential results of several early and recent model calculations of density, incompressibility, and pressure are summarized for the Earth and Mars, with occasional references to Venus. Well-determined observational data in this field are few, so that the degree of precision attached to the observations of mass and radii of the planets considered is of central importance. A series of formal calculations not closely tied to favored theories is currently in progress with the intention of showing the range of permissible types of models under given values of mass, mean radius, and surface ellipticity.—JPF

01340 **Burke, Robert Francis.** Multi-band aerial photography in geological analysis simulating orbital satellite photography of planetary bodies [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 8, p. 3336B, 1968.

06966 **Burwell, H. B.** Well sample descriptions and drillers' logs, Morgan County, Tennessee: Tennessee Div. Geology Rept. Inv. 20, 175 p., 1967.

This report presents all available drillers' logs and lithologic descriptions of all available samples from oil and gas tests drilled to date in the County. Tests are indexed alphabetically by operator and landowner at the beginning of the report. Stratigraphic interpretations, which follow each log and description, are based on current work and give the Ordovician to Pennsylvanian formations covered by each.—ESL

06967 **Burwell, H. B.** Well sample descriptions and drillers' logs, Scott County, Tennessee: Tennessee Div. Geology Rept. Inv. 21, 201 p., 1967.

This report presents all available drillers' logs and lithologic descriptions of all available samples from oil and gas tests drilled to date in the County. Tests are indexed alphabetically by operator and landowner at the beginning of the report. Stratigraphic interpretations, which follow each log and description, are based on current work and give the Ordovician to Pennsylvanian formations covered by each.—ESL

01384 **Bush, A. L.; Sweeney, John W.** Lightweight aggregates, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 210–224, illus., tables, 1968.

A brief summary of the origin and occurrence of lightweight aggregate in Appalachia is given. Expanded clay, shale, slate, expanded slag, and vermiculite are considered; data are tabulated. Very little geological information is included.—HRC

01365 **Butler, Arthur P., Jr.; Stansfield, Robert G.** Uranium, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 443–449, illus., 1968.

Except for one poorly-defined body in West Virginia, all of the uranium in Appalachia comes from Pennsylvania, where it occurs in sedimentary rocks. An extremely brief description of the occurrence is given. Uranium also is known from pegmatites in the Piedmont area, but none is in commercial quantities. A little occurs disseminated in the Devonian–Mississippian black shale, but none is economical at present.—HRC

07055 **Butler, P. M.; Clemens, W. A.; Graham, S. F.; Hooijer, D. A.; Kermack, K. A.; Patterson, B.; Ride, W. D. L.; Russell, D. E.; Savage, R. J. G.; Simons, E. L.** (and others). Mammalia, Chap. 30 *in* The fossil record—A symposium with documentation: London, Geol. Soc. London, p. 763–787, illus., 1967.

The classification used here and the order of taxa listed are those given by Simpson (1945). Additions are the subclass Eotheria, four orders of Metatheria, and four of Eotheria. Certain groups have a multiple documentation which seems to reflect the real difficulty of assigning the small generalized mammals from the late Mesozoic and basal Tertiary to clearly defined orders. The range of 22 families, 2 infraorders, 45 suborders, and 24 orders is documented, and 3 range charts are included.—ESL

01612 **Cailleux, André.** Étude morphoscopique de sables non marins de l'Alaska: Soc. Géol. France Compte Rendu 1968, no. 1, p. 21, 1968.

A morphologic study was done on twelve samples of Cenozoic fluviatile, lacustrine, fluvioglacial, and eolian sands from central Alaska. Beveled and polished grains are the result of water wear; frosted grains, beveled or polished, are the result of wind action; and the third, and clearly dominant type, is angular, unworn grains, typical of mountain areas with rapid disintegration of rocks.—ESL

Callahan, William R. *See* Hovis, W. A., Jr. 01680

06964 **Callison, George.** Intracranial mobility in Kansas mosasaurs: Kansas Univ. Paleont. Contr.—Paper 26, 15 p., illus., 1967.

Three genera of mosasaurs (*Clidastes, Platecarpus, Tylosaurus*) [Upper Cretaceous, western Kansas] are analyzed in terms of cranial kinesis, strepostyly, and intramandibular mobility. Mechanisms of cranial kinesis found in the mosasaurs are similar to those found in [the modern lizard] *Varanus*. The specialized quadrate of mosasaurs differs much from the generalized varanid quadrate in that the cephalic condyle is long and has an inward-bending articulatory surface. The mechanical regime provided by the enhanced streptostyly permits the intramandibular joint to be operated by action of the pterygoid and cervicomandibular muscles.—Author's abstract

01334 **Calvert, Warren L.; Bernhagen, Ralph J.; Bowman, Richard S.** Detailed discussion of outcrops observed at Ohio field stops, Friday, May 17, 1968, *in* Geological aspects of the Maysville–Portsmouth region, southern Ohio and northeastern Kentucky—Ohio Geol. Soc.–Geol. Soc. Kentucky, Joint Field Conf. 1968: [Lexington, Ky.] Kentucky Geol. Survey, p. 21–37, illus., 1968.

Special features in previously measured sections, pointed out in this trip in Scioto and Adams Counties, include the conglomerate nature and plant fragments of the Sharon sandstone, its unconformity with the Vinton Siltstone; the Byer Siltstone rock floor of the pre-Pleistocene Teays River and Pleistocene fill (Minford Silt); dimension stone properties in McDermott quarries of Buena Vista Sandstone, Bedford Shale and Berea Sandstone; the Silurian–Devonian stratigraphic units and structure in Plum Run Quarry (condensed from Bowman, 1961); the Ordovician–Silurian contact and units in the Ohio Brush Creek section; and the Trebor Run exposure of the Whitewater limestone member of the Richmond Formation. Illustrations include a geologic sketch map and stratigraphic section of Plum Run Quarry, and correlation in the Brush Creek section.—GDC

01336 **Calvert, Warren L.** (compiler). Surface and subsurface stratigraphy of Adams and Scioto Counties, Ohio, *in* Geological aspects of the Maysville–Portsmouth region, southern Ohio and northeastern Kentucky—Ohio Geol. Soc.–Geol. Soc. Kentucky, Joint Field Conf. 1968: [Lexington, Ky.] Kentucky Geol. Survey, p. 63–87, illus., 1968.

The geologic column presented here for Adams and Scioto Counties has evolved over a span of 130 years; minor adjustments are suggested as a result of surface and subsurface studies by the writer. Areal distribution of units is shown on a generalized geologic map; due to an eastward dip, Ordovician and Silurian rocks crop out only in Adams County, Devonian strata along the Adams–Scioto County line, Mississippian mostly in Scioto County, and Pennsylvanian are confined to the eastern part. The lithologic units of each of these systems are described briefly, including names of characteristic fossils. This exposed section is the thin, cratonic extension of a much thicker subsurface section in the Appalachian basin to the east. A cross section shows the correlation of the Adams County outcrop with the subsurface as far east as Noble County, Ohio.—GDC

01398 **Cameron, Cornelia C.** Peat, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 136–145, illus., tables, 1968.

In a cursory account of the occurrence of peat in Appalachia, numerous deposits in New York, Pennsylvania, and West Virginia are described. Many peat bogs are associated with glacial terrane or are in floodplain areas.—HRC

01241 **Canada Geological Survey.** Aeromagnetic map, Perron–Rousseau, Quebec: Canada Geol. Survey Geophysics Paper 5346, scale 1:63,360, 1968.

01242 **Canada Geological Survey.** Aeromagnetic map, Collet–Laberge, Quebec: Canada Geol. Survey Geophysics Paper 5347, scale 1:63,360, 1968.

01243 **Canada Geological Survey.** Aeromagnetic map, Récher–Raymond, Quebec: Canada Geol. Survey Geophysics Paper 5348, scale 1:63,360, 1968.

01244 **Canada Geological Survey.** Aeromagnetic map, Rivière Turgeon, Quebec: Canada Geol. Survey Geophysics Paper 5349, scale 1:63,360, 1968.

01245 **Canada Geological Survey.** Aeromagnetic map, Martigny, Quebec: Canada Geol. Survey Geophysics Paper 5350, scale 1:63,360, 1968.

01246 **Canada Geological Survey.** Aeromagnetic map, Lac des Chasseurs, Quebec: Canada Geol. Survey Geophysics Paper 4983, scale 1:63,360, 1968.

01247 **Canada Geological Survey.** Aeromagnetic map, Lac Humqui, Quebec: Canada Geol. Survey Geophysics Paper 4984, scale 1:63,360, 1968.

01248 **Canada Geological Survey.** Aeromagnetic map, Milnikek, Quebec: Canada Geol. Survey Geophysics Paper 4999, scale 1:63,360, 1968.

01249 **Canada Geological Survey.** Aeromagnetic map, Causapscal, Quebec: Canada Geol. Survey Geophysics Paper 5000, scale 1:63,360, 1968.

01250 **Canada Geological Survey.** Aeromagnetic map, Saint–Vianney, Quebec: Canada Geol. Survey Geophysics Paper 5001, scale 1:63,360, 1968.

01251 **Canada Geological Survey.** Aeromagnetic map, Oak Bay, Quebec–New Brunswick: Canada Geol. Survey Geophysics Paper 5015, scale 1:63,360, 1968.

01252 **Canada Geological Survey.** Aeromagnetic map, Ruisseau Jérome, Quebec: Canada Geol. Survey Geophysics Paper 5016, scale 1:63,360, 1968.

01253 **Canada Geological Survey.** Aeromagnetic map, Boutet, Quebec: Canada Geol. Survey Geophysics Paper 5017, scale 1:63,360, 1968.

01254 **Canada Geological Survey.** Aeromagnetic map, Mont Logan, Quebec: Canada Geol. Survey Geophysics Paper 5018, scale 1:63,360, 1968.

01255 **Canada Geological Survey.** Aeromagnetic map, Rivière Angers, Quebec: Canada Geol. Survey Geophysics Paper 5032, scale 1:63,360, 1968.

01256 **Canada Geological Survey.** Aeromagnetic map, Monts Big Berry, Quebec: Canada Geol. Survey Geophysics Paper 5033, scale 1:63,360, 1968.

01257 **Canada Geological Survey.** Aeromagnetic map, Mont Albert, Quebec: Canada Geol. Survey Geophysics Paper 5034, scale 1:63,360, 1968.

01258 **Canada Geological Survey.** Aeromagnetic map, Chu Chua Creek, British Columbia: Canada Geol. Survey Geophysics Paper 5224, scale 1:63,360, 1968.

01259 **Canada Geological Survey.** Aeromagnetic map, Bridge Lake, British Columbia: Canada Geol. Survey Geophysics Paper 5225, scale 1:63,360, 1968.

01260 **Canada Geological Survey.** Aeromagnetic map, Green Lake, British Columbia: Canada Geol. Survey Geophysics Paper 5226, scale 1:63,360, 1968.

01261 **Canada Geological Survey.** Aeromagnetic map, 100 Mile House, British Columbia: Canada Geol. Survey Geophysics Paper 5227, scale 1:63,360, 1968.

01262 **Canada Geological Survey.** Aeromagnetic map, Deka Lake, British Columbia: Canada Geol. Survey Geophysics Paper 5228, scale 1:63,360, 1968.

01263 **Canada Geological Survey.** Aeromagnetic map, Clearwater, British Columbia: Canada Geol. Survey Geophysics Paper 5229, scale 1:63,360, 1968.

01264 **Canada Geological Survey.** Aeromagnetic map, Mahood Lake, British Columbia: Canada Geol. Survey Geophysics Paper 5230, scale 1:63,360, 1968.

01265 **Canada Geological Survey.** Aeromagnetic map, Canim Lake, British Columbia: Canada Geol. Survey Geophysics Paper 5231, scale 1:63,360, 1968.

01266 **Canada Geological Survey.** Aeromagnetic map, Lac la Hache, British Columbia: Canada Geol. Survey Geophysics Paper 5232, scale 1:63,360, 1968.

01267 **Canada Geological Survey.** Aeromagnetic map, 150 Mile House, British Columbia: Canada Geol. Survey Geophysics Paper 5233, scale 1:63,360, 1968.

01268 **Canada Geological Survey.** Aeromagnetic map, Murphy Lake, British Columbia: Canada Geol. Survey Geophysics Paper 5234, scale 1:63,360, 1968.

01269 **Canada Geological Survey.** Aeromagnetic map, McKinley Creek, British Columbia: Canada Geol. Survey Geophysics Paper 5235, scale 1:63,360, 1968.

01270 **Canada Geological Survey.** Aeromagnetic map, Clearwater Lake, British Columbia: Canada Geol. Survey Geophysics Paper 5236, scale 1:63,360, 1968.

01271 **Canada Geological Survey.** Aeromagnetic map, Azure Lake, British Columbia: Canada Geol. Survey Geophysics Paper 5237, scale 1:63,360, 1968.

01272 **Canada Geological Survey.** Aeromagnetic map, MacKay River, British Columbia: Canada Geol. Survey Geophysics Paper 5238, scale 1:63,360, 1968.

01273 **Canada Geological Survey.** Aeromagnetic map, Horsefly, British Columbia: Canada Geol. Survey Geophysics Paper 5239, scale 1:63,360, 1968.

01274 **Canada Geological Survey.** Aeromagnetic map, Barriere Lake, British Columbia: Canada Geol. Survey Geophysics Paper 5321, scale 1:63,360, 1968.

01275 **Canada Geological Survey.** Aeromagnetic map, St. Anthony, Newfoundland: Canada Geol. Survey Geophysics Paper 4418, scale 1:63,360, 1968.

01276 **Canada Geological Survey.** Aeromagnetic map, Ferolle Point, Newfoundland: Canada Geol. Survey Geophysics Paper 4419, scale 1:63,360, 1968.

01277 **Canada Geological Survey.** Aeromagnetic map, Brig Bay, Newfoundland: Canada Geol. Survey Geophysics Paper 4420, scale 1:63,360, 1968.

01278 **Canada Geological Survey.** Aeromagnetic map, Salmon River, Newfoundland: Canada Geol. Survey Geophysics Paper 4421, scale 1:63,360, 1968.

01279 **Canada Geological Survey.** Aeromagnetic map, St. Julien's, Newfoundland: Canada Geol. Survey Geophysics Paper 4422, scale 1:63,360, 1968.

01280 **Canada Geological Survey.** Aeromagnetic map, St. John Island, Newfoundland: Canada Geol. Survey Geophysics Paper 4423, scale 1:63,360, 1968.

01281 **Canada Geological Survey.** Aeromagnetic map, Castors River, Newfoundland: Canada Geol. Survey Geophysics Paper 4424, scale 1:63,360, 1968.

01282 **Canada Geological Survey.** Aeromagnetic map, Roddickton, Newfoundland: Canada Geol. Survey Geophysics Paper 4425, scale 1:63,360, 1968.

01283 **Canada Geological Survey.** Aeromagnetic map, Groais Island, Newfoundland: Canada Geol. Survey Geophysics Paper 4426, scale 1:63,360, 1968.

01284 **Canada Geological Survey.** Aeromagnetic map, Port Saunders, Newfoundland: Canada Geol. Survey Geophysics Paper 4427, scale 1:63,360, 1968.

01285 **Canada Geological Survey.** Aeromagnetic map, Torrent River, Newfoundland: Canada Geol. Survey Geophysics Paper 4428, scale 1:63,360, 1968.

01286 **Canada Geological Survey.** Aeromagnetic map, Englee, Newfoundland: Canada Geol. Survey Geophysics Paper 4429, scale 1:63,360, 1968.

01287 **Canada Geological Survey.** Aeromagnetic map, Grey Island Harbour, Newfoundland: Canada Geol. Survey Geophysics Paper 4430, scale 1:63,360, 1968.

01288 **Canada Geological Survey.** Aeromagnetic map, Bellburns, Newfoundland: Canada Geol. Survey Geophysics Paper 4431, scale 1:63,360, 1968.

01289 **Canada Geological Survey.** Aeromagnetic map, Blue Mountain, Newfoundland: Canada Geol. Survey Geophysics Paper 4432, scale 1:63,360, 1968.

01290 **Canada Geological Survey.** Aeromagnetic map, Harbour Deep, Newfoundland: Canada Geol. Survey Geophysics Paper 4433, scale 1:63,360, 1968.

01291 **Canada Geological Survey.** Aeromagnetic map, Otange Bay, Newfoundland: Canada Geol. Survey Geophysics Paper 4434, scale 1:63,360, 1968.

01292 **Canada Geological Survey.** Aeromagnetic map, Portland Creek, Newfoundland: Canada Geol. Survey Geophysics Paper 4435, scale 1:63,360, 1968.

01293 **Canada Geological Survey.** Aeromagnetic map, Indian Lookout, Newfoundland: Canada Geol. Survey Geophysics Paper 4436, scale 1:63,360, 1968.

01294 **Canada Geological Survey.** Aeromagnetic map, Cat Arm River, Newfoundland: Canada Geol. Survey Geophysics Paper 4437, scale 1:63,360, 1968.

01295 **Canada Geological Survey.** Aeromagnetic map, Fleur de Lys, Newfoundland: Canada Geol. Survey Geophysics Paper 4438, scale 1:63,360, 1968.

01296 **Canada Geological Survey.** Aeromagnetic map, Horse Islands, Newfoundland: Canada Geol. Survey Geophysics Paper 4439, scale 1:63,360, 1968.

01297 **Canada Geological Survey.** Aeromagnetic map, St. Paul's Inlet, Newfoundland: Canada Geol. Survey Geophysics Paper 4440, scale 1:63,360, 1968.

01298 **Canada Geological Survey.** Aeromagnetic map, Main River, Newfoundland: Canada Geol. Survey Geophysics Paper 4441, scale 1:63,360, 1968.

01299 **Canada Geological Survey.** Aeromagnetic map, Jackson's Arm, Newfoundland: Canada Geol. Survey Geophysics Paper 4442, scale 1:63,360, 1968.

01300 **Canada Geological Survey.** Aeromagnetic map, Baie Verte, Newfoundland: Canada Geol. Survey Geophysics Paper 4443, scale 1:63,360, 1968.

01301 **Canada Geological Survey.** Aeromagnetic map, Estcourt, Quebec–New Brunswick: Canada Geol. Survey Geophysics Paper 4930, scale 1:63,360, 1968.

01302 **Canada Geological Survey.** Aeromagnetic map, Pinware, Newfoundland: Canada Geol. Survey Geophysics Paper 3512, scale 1:63,360, 1968.

01303 **Canada Geological Survey.** Aeromagnetic map, Sheet 42 K/12, District of Cochrane, Ontario: Canada Geol. Survey Geophysics Paper 3847, scale 1:63,360, 1968.

01304 **Canada Geological Survey.** Aeromagnetic map, Sheet 42 K/13, District of Cochrane, Ontario: Canada Geol. Survey Geophysics Paper 3848, scale 1:63,360, 1968.

01305 **Canada Geological Survey.** Aeromagnetic map, Sheet 42 N/4, District of Cochrane, Ontario: Canada Geol. Survey Geophysics Paper 3849, scale 1:63,360, 1968.

01307 **Canada Geological Survey.** Aeromagnetic map, Ogoki, Districts of Kenora and Cochrane, Ontario: Canada Geol. Survey Geophysics Paper 3851, scale 1:63,360, 1968.

01308 **Canada Geological Survey.** Aeromagnetic map, Sheet 42 N/13, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3852, scale 1:63,360, 1968.

01309 **Canada Geological Survey.** Aeromagnetic map, Streatfeild Lake, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3853, scale 1:63,360, 1968.

01310 **Canada Geological Survey.** Aeromagnetic map, Sheet 43 C/5, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3854, scale 1:63,360, 1968.

01311 **Canada Geological Survey.** Aeromagnetic map, Sheet 43 C/12, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3855, scale 1:63,360, 1968.

01312 **Canada Geological Survey.** Aeromagnetic map, Big Brook, Newfoundland: Canada Geol. Survey Geophysics Paper 4413, scale 1:63,360, 1968.

01313 **Canada Geological Survey.** Aeromagnetic map, Raleigh, Newfoundland: Canada Geol. Survey Geophysics Paper 4414, scale 1:63,360, 1968.

01314 **Canada Geological Survey.** Aeromagnetic map, Quirpon, Newfoundland: Canada Geol. Survey Geophysics Paper 4415, scale 1:63,360, 1968.

01315 **Canada Geological Survey.** Aeromagnetic map, Flower's Cove, Newfoundland: Canada Geol. Survey Geophysics Paper 4416, scale 1:63,360, 1968.

01316 **Canada Geological Survey.** Aeromagnetic map, Eddies Cove, Newfoundland: Canada Geol. Survey Geophysics Paper 4417, scale 1:63,360, 1968.

Carozzi, Albert V. *See* Agassiz, Louis. 06998

01604 **Carr, P. A.** Salt-water intrusion studies in the Maritimes: Maritime Sediments, v. 3, no. 4, p. 109–111, illus., 1967 [1968].

Hydrogeologic investigations in three Maritime areas where detailed records have been compiled since 1965 are described briefly. On Prince Edward Island no heavy pumping occurs around the Eliot River estuary, where a large flow of fresh water discharges from a zone 200 to 600 feet below sea level, with salt water above and below. Centered along the nearby Georgetown Peninsula are 8 wells, each about 350 feet below sea level, in poorly fractured rocks, so ground-water withdrawal is limited. At Shippegan, New Brunswick, salt-water intrusion is most severe from abandoning of over-pumped wells and repeated drilling further inland; the resulting cone of depression causes fresh water to rise above intruded sea water. Pump-test wells installed in the zone of diffusion help maintain safe yield by detecting change in salinity.—GDC

07019 **Carrigy, Maurice A.** Some sedimentary features of the Athabasca oil sands: Sed. Geology, v. 1, no. 4, p. 327–352, illus., 1967.

Sedimentary structures in oil sands of northern Alberta include some large- and very large-scale features, such as deltaic foreset bedding and planar and trough cross-stratification, and many small-scale features including micro-cross-lamination and structures due to disruption and disturbance of horizontal laminae of silt by slumping, loadcasting, faulting, and burrowing. These features are believed to have formed in environments of deposition ranging from fluviatile at the base, through shallow-water deltaic in the middle, to open-sea marine at the top. This sequence of strata is thought to have been laid down in quick succession and preserved without major erosion. Predominance of lateral processes in accumulation of the strata makes local bed-to-bed correlation difficult and a knowledge of primary sedimentary structures is of practical importance in the economic exploration and exploitation of this vast petroleum reserve.—*from* Author's abstract

07093 **Carrington, Thomas J.** Talladega Group of Alabama, *in* A field guide to carboniferous detrital rocks in northern Alabama—Geol. Soc. America, Coal Div., 1967 Field Trip: University, Ala., Alabama Geol. Soc., p. 24–27, 1967.

The rocks are low-rank metamorphosed sedimentary rocks probably of predominantly Carboniferous age, and may be the meta-equivalents of the section near Birmingham, with many of the units having been removed and replaced by unconformities. The Talladega belt is bounded on the north and west by a fault or metamorphic front. To the south and east the boundary is either a fault or more highly metamorphosed Talladega rocks. The thickness ranges from 11,000 to 28,000 feet, but details of the structure and stratigraphy need to be determined; several mappable units are recognized. Probable Devonian fossils and Mississippian spores are reported. Some of the group may well be Cambrian and/or Ordovician also. The abandonment of the group name is suggested.—HRC

01231 **Carroll, Dorothy.** Clay minerals in Arctic Ocean sea-floor sediments [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 522, 1968.

01515 **Carson, Charles E.** Radiocarbon dating of lacustrine strands in arctic Alaska [with French and Russian abs.]: Arctic, v. 21, no. 1, p. 12–26, illus., table, 1968.

Lacustrine shelves 10 to 12 miles inland from the arctic coast of Alaska occur in response to intersection and drainage by tundra streams. Near Point Barrow, these surfaces require 10 to 20 years for revegetation in today's climate. Many relict lakes in the area are surrounded by a stabilized sequence of 2 to 4 ancient strands, suggesting previous more common regional piracy. Dates from 30 radiocarbon samples indicate the majority of relict strands are less than 3,500 years old, but with such a limited number of dates, neither equivalent levels nor similar sequences can establish clear time-correlation. However, the data perhaps suggest a maximum lacustrine expansion near the end of the hypsithermal around 3,500–4,000 years ago and that the onset of the post-hypsithermal cooling phase corresponds in time with the initial period of draining.—*from* Author's abstract

01371 **Carter, W. D.** Silica, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 337–354, illus., tables, 1968.

Silica resources are abundant and widespread in Appalachia. Silica occurs primarily as quartz in sandstone and conglomerate formations, although residual and fluvial quartz sands are present also. Deposits in each of the states are reviewed cursorily.—HRC

07129 **Caster, Kenneth E.** Homoiostelea, *in* Treatise on invertebrate paleontology—Pt. S, Echinodermata 1, V. 2: New York, Geol. Soc. America (and Univ. Kansas Press), p. S581–S627, illus., 1967.

Homoiostelea Gill and Caster, 1960, here raised to class rank in the subphylum Homalozoa, comprises one order, Soluta, with seven families and 10 genera; they range from Upper Cambrian through Lower Devonian, with maximum in the Ordovician. Homoiostelea have an asymmetrical, depressed theca as in other carpoids, but with less differentiation of marginal plates. They have a bilaterally tetramerous subvective arm containing the ambulacrum, and a bilaterally tetramerous stele, in three zones, which resembles the stylophoran aulacophore but had only locomotor function. Caster suggests that all exothecal tetramerous appendages in carpoids are radially homologous; a speculative phylogeny shows divergence of carpoids and pentaradiate echinoderms from a hypothetical triradiate ancestor.—VMJ

Castillo-Tejero, Carlos. *See* Viniegra, Francisco. 01205

Chaloner, W. G. *See* Banks, H. P. 07070

Chang, Sherwood. *See* Rabinowitz, Joseph. 01635

01581 **Chayes, F.** Negative variances among theoretical open variables formed from Harker arrays: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 505–510, table, 1968.

Subjects discussed are: closure correlation, a review of general relations; algebraic controls on the signs of elements in σ; signs of elements in σ calculated from Harker arrays; modifying U by linear combination; and some proposed transformations for Harker data. A table shows incidence of negative elements in the open variance vectors of some transformed Harker arrays.—ESL

01479 **Chen, Pei-Yuan.** A modification of sandstone classification: Jour. Sed. Petrology, v. 38, no. 1, p. 54–60, illus., tables, 1968.

The system includes a complete rock nomenclature based on parameters of sedimentary structure, grain texture, maturity, cementing material and primary detrital mineral composition. Detrital composition is based on a three-pole arrangement in which are delineated quartzose, feldspathic and lithic suites. Special names are provided for certain rock types within the suites. Each suite has particular tectonic significance.—RAC

Chilingar, George V. *See* Harton, James H. 07038

Chilingar, George V. *See* Adamson, Lucas G. 07039

07041 **Christiansen, E. A.** Geology and groundwater resources of the Saskatoon area (73–B), Saskatchewan: Saskatchewan Research Council Geology Div. Map 7, scale 1:250,000, sections, text, 1967.

The Cretaceous Oldman Formation, an aquifer in the southern part of the Saskatoon area, is capable of yielding only small supplies of water (0–100,000 gpd); total dissolved solids in five analyses range from 1,300–3,400 ppm of sodium sulfate water. Sand and gravel aquifers occur on the present land surface, between tills and between till and bedrock, within tills, and in preglacial valleys; thickness ranges from a few feet to more than 100 feet. Thickness of drift ranges from a few feet to more than 800 feet. Aquifers in drift are capable of yielding a few thousand to more than one million gpd. Total dissolved solids in four analyses from the Battleford and Tyner Valley aquifers ranges from 1,190–3,250 ppm.—MCM

01493 **Churcher, C. S.; Fenton, M. Brock.** Vertebrate remains from the Dickson Limestone Quarry, Halton County, Ontario, Canada: Natl. Speleol. Soc. Bull., v. 30, no. 1, p. 11–16, illus., tables, 1968.

In a crevice cave in the Niagara Escarpment, exposed by quarrying, stratified, partly consolidated deposits above and below vertical flowstone sheets were apparently formed at fluctuating water levels on the floor of the cave. These deposits have yielded remains of at least 10 extant species of small mammals: two shrews, at least three bats, and five rodents. There are few references in the literature to late Pleistocene or post–Wisconsin fossils of insectivores, chiropterans, or rodents in Canada; one deposit in Ontario containing rodents has been radiocarbon dated at about 3550 B.C. Radiocarbon dating of the present deposit was not attempted, but presence of a bone fragment of wapiti (*Cervus canadensis*), now extinct in Ontario, suggests a minimum age of 215 years.—VMJ

01487 **Clark, Janet.** (compiler). Bibliography of vertebrate paleontology and related subjects: Soc. Vertebrate Paleontology Bibliography 1966–67, no. 22, 84 p., 1968.

Clarke, W. J. *See* Banner, F. T. 07074

Clausen, Eric N. *See* Doehring, Donald O. 07020

01524 **Clayton, Robert N.; Jones, Blair F.; Berner, Robert A.** Isotope studies of dolomite formation under sedimentary conditions: Geochim. et Cosmochim. Acta, v. 32, no. 4, p. 415–432, illus., tables, 1968.

Measurements of stable isotope abundances of the carbonate portion of the sediment in Deep Springs Lake, Calif., indicate the presence of at least three phases: (1) a magnesian calcite, (2) a primary sedimentary dolomite, and (3) a detrital dolomite. The former two have isotopic compositions consistent with precipitation at isotopic equilibrium from waters of the lake area. The measured isotopic fractionation factor between sedimentary dolomite and its interstitial water is 1.0351, which is outside the range possible for calcite–water. This indicates that the dolomite has formed by direct crystallization from solution and not from a calcite precursor without further isotope exchange. Isotopic and X-ray evidence does not support the contention of Peterson and others (1966) that Deep Springs Lake dolomite crystals grow by means of a calcite–like surface layer.—Authors' abstract

Clemens, W. A. *See* Butler, P. M. 07055

01650 **Clemens, William A., Jr.** A mandible of *Didelphodon vorax* (Marsupialia, Mammalia): Los Angeles County Mus. Contr. Sci., no. 133, 11 p., illus., table, 1968.

A fragment of a mandible of *Didelphodon vorax* found in the Hell Creek Formation, Montana, confirms the provisional identification of lower premolars and molars of this species, establishes the orientation of the lower premolars, and serves as the basis for further speculation on the orientation of the upper premolars. The functional significance of prominent lateral lobes on mammalian premolars is examined.—Author's abstract

01609 **Clowes, R. M.; Kanasewich, E. R.; Cumming, G. L.** Deep crustal seismic reflections at near–vertical incidence: Geophysics, v. 33, no. 3, p. 441–451, illus., 1968.

Seismic reflections from discontinuities deep within the crust (reflection times 8–16 sec) have been recorded along four lines over a widespread area in southern Alberta for a total of 90 km of near–vertical–incidence profiling. Along one profile an expanding spread was utilized and a strong reflection at 11.6 sec was continuously correlated over nearly 25 km. A least–squares analysis of the X^2, T^2 plot gives an average vertical velocity of 6.2 kmps to a depth of 34 km. Continuous profiling along a line 40 km long resulted in a seismic cross section which shows structural relief of 8 km over a distance of 25 km. These results indicate that the reflection technique with its high resolving power may be used to map complicated structures which even a detailed refraction survey may fail to delineate. It is probable that

many continental areas have similar crustal complexities undetected by the refraction method.—*from* Authors' abstract

07016 **Clyde, Calvin G.; Jensen, Bartell C.; Milligan, James H.** Optimizing conjunctive use of surface water and groundwater, *in* Groundwater development in arid basins—Symposium, Utah State Univ., 1967, Proc.: Logan, Utah, Utah State Univ., p. 59–86, illus., tables, 1967.

Planning and execution of the best possible programs for conservation and control of water should be recognized as one of our most important natural resource problems. The first attempts to integrate surface and ground-water resources into a conjunctive use system have come only in the last few years. Objectives of the Utah Water Research Laboratory project are listed and development of a groundwater—surface-water model described. Linear programming was applied, and the constraint system, objective function, and definition of variables given, and a matrix tableau shown. Optimization using the Simplex procedure is described, and sections of computer output are tabulated. Linear programming optimization, with accompanying post-optimal analysis, is proved to be a powerful tool for water resource designing.—ESL

01671 **Coates, M. E.** Black Sturgeon Lake area (west half) and (east half), District of Thunder Bay: Ontario Dept. Mines Prelim. Geol. Maps P. 462 and 463, scale 1 in. to 1 mi., text, 1968.

Oldest formations in the Black Sturgeon Lake area are metamorphosed equivalents of early Precambrian sedimentary and volcanic rocks; these and the granite migmatite complex which encloses them constitute the basement for the entire map-area. Youngest Precambrian rocks are igneous intrusions, dikes and sills of diabase, which now mantle much of the older rock. Foliation trend is generally about N. 20°–30° E.; where rocks of the overlying Sibley Group are undisturbed, bedding is horizontal or dips at low angles. Normal faulting with NW–SE, NE–SW, and N–S trends are recognized. Occurrences of copper, iron, and marl have been discovered.—MCM

01437 **Colburn, Ivan P.** Grain fabrics in turbidite sandstone beds and their relationship to sole mark trends on the same beds: Jour. Sed. Petrology, v. 38, no. 1, p. 146–158, illus., 1968.

Mean orientations of elongate grains in thin sections of 62 samples from Cretaceous turbidite beds in central western California agree within statistically significant limits with the orientations of the basal sole marks of the respective beds. The high standard deviation of the means, 35°, suggests that a large number of samples are required to determine the regional trend within reasonable confidence limits. Best alignment of grain elongation with sole marks is present in the lower middle portion of the beds. Orientation of dips of imbricated grains was measured in one bed at three levels; only dips at the basal level were in significant agreement with orientation of sole markings. Disagreement in imbrication orientations may be attributed to backwash, and variation in elongate grain orientations to changes in shape and velocity of the body of sediment as it was transported by the turbidity current.—RAC

Coleman, James M. *See* Ho, Clara. 01218

06968 **College Publishing Corporation.** How to pass graduate record examination—Advanced test, geology: New York, College Publishing Corp., unpaged, 1964 [1967].

In addition to 12 multiple-choice tests, the book contains a list of graduate schools in the United States.—MCM

Collett, M. G. *See* Banks, H. P. 07070

01591 **Collins, Jim.** The geology of the McAllen–Pharr Field area, Hidalgo County, Texas [Pts. 1–3]: South Texas Geol. Soc. Bull., v. 8, no. 3, p. 2–9, illus.; ibid., no. 4, p. 3–9, illus.; ibid., no. 5, p. 6–[13], illus., table, reprinted 1968.

The McAllen–Pharr Field produces gas and gas-condensate from Frio Sands between depths of 13,765 and 5,800 feet. The environment of deposition ranges from shallow marine through brackish to continental, a regressive offlap sequence. Hydrocarbon entrapment occurs in a simple faulted anticline in the Upper Frio, a large stratigraphic trap in the Hansen Sand, and many small complex fault blocks in the Lower Frio. The structural change from simple downthrown closure with basinward dip to a complex with away-from-basin dips occurs in the shale above the 8500-ft sand, indicating a hiatus or unconformity which is indicated by an abrupt change in pressure gradient. [This paper originally appeared in Corpus Christi Geol. Soc. Bull., v. 8, no. 4, p. 7–32.]—*from* Author's abstract

01232 **Colquhoun, Donald J.** Faunal isolation near primary strandlines [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 522–523, 1968.

01453 **Colvin, R. G.** Orrin Jerold Wangsness (1917–1967): Am. Assoc. Petroleum Geologists Bull., v. 52, no. 4, p. 709–710, portrait, 1968.

01397 **Conant, Louis C.; Stansfield, Robert G.** Oil shale, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 133–136, illus., 1968.

A generalized account of the occurrence of black shales in Appalachia is given. The Devonian–Mississippian black shale lithosome is one major source, and the black shales in the coal-bearing formations of Pennsylvanian age are another. Currently, none is economical, but reserves are present.—HRC

07023 **Condie, Kent C.** Petrologic reconnaissance of the Precambrian rocks in Wind River Canyon, central Owl Creek Mountains, Wyoming: Wyoming Univ. Contr. Geology, v. 6, no. 2, p. 123–129, illus., tables, geol. map, 1967.

The Precambrian rocks are hornblende-plagioclase and hornblende-cummingtonite amphibolites, biotite-quartz schists, and a quartz monzonite intrusive and associated granitic dikes and pegmatites, metamorphosed to the amphibolite facies. The massive character and comparatively mafic composition of the hornblende-plagioclase amphibolites suggest that they are ortho-amphibolites; a more silicic and alkalic composition and the occurrence of uniform layering in the hornblende-cummingtonite amphibolites suggest that they are para-amphibolites. Potash feldspar and sodic plagioclase in the amphibolites and schists surrounding the intrusive resulted from incipient Na and K metasomatism which accompanied emplacement of the intrusive.—*from* Author's abstract

07100 **Coode, A. M.** The spherical harmonic analysis of major tectonic features, *in* Mantles of the Earth and terrestrial planets (S. K. Runcorn, editor): London and New York, Interscience Publishers, p. 489–498, illus., 1967.

Analyses using Dirac delta functions distributed among all the major active tectonic features at the Earth's surface show that tension and compression features are formed by the same mechanism, thus strengthening the convection theory of their origin.—JPF

Cook, H. E. *See* Pray, L. C. 01185

Copeland, R. A. *See* Mencher, Ely. 01435

Copland, A. B. *See* Barss, D. L. 01324

Copper, P. *See* Ager, D. V. 07073

01338 **Cording, Edward James.** The stability during construction of three large underground openings in rock [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 8, p. 3271B–3272B, 1968.

Corliss, John B. *See* Gordon, Glen E. 01513

01377 **Cornwall, H. R.; Vhay, J. S.; Frendzel, Donald J.** Cobalt and nickel, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 374–376, illus., 1968.

In Appalachia, nickel and minor amounts of cobalt occur in nickeliferous laterite in southwestern North Carolina. The largest laterite deposits, with more than 0.5 percent nickel, are in Jackson county. Cobaltiferous and nickeliferous sulfides also occur in Virginia and are associated with sulfide bodies throughout Appalachia. At this time none are economically attractive.—HRC

01341 **Couch, Elton Leroy.** Boron sorption and fixation by illites [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 8, p. 3336B, 1968.

Couch, R. W. *See* Bostrom, R. C. 01522

01370 **Cox, Dennis P.; Edgerton, Curt D., Jr.** Salines, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 327–337, illus., tables, 1968.

A cursory description of the occurrence of rock salt in Appalachia is given, although no new data are included. Salt beds of Silurian age underlie the northern part of the region, and some of Mississippian age occur in Virginia. Natural brines occur also in some of the oil-bearing sandstones in the northern part. The resource potential is promising.—HRC

01372 **Cox, Dennis P.** Strontium, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 354–355, 1968.

Because known deposits of strontium-bearing minerals in Appalachia are small and low grade, the potential is small. Celestite occurs in veins in the Appalachian Plateau area, but none is now being mined; strontium is found as a trace element in the barite deposits of the region.—HRC

Cox, Dennis P. *See* Ericksen, George E. 01386

Cox, Dennis P. *See* Miller, Ralph L. 01392

01233 **Craig, D. H.; Schoonmaker, G. R.** Yates oil field, Pecos County, Texas [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 523, 1968.

01554 **Craig, J. R.; Kullerud, G.** The Cu–Fe–Ni–S system: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 413–417, illus., 1968.

Phase relations for the system are presented in schematic diagrams for 1000° and for 850°C. At 1000°C, liquid and $Fe_{1-x}S$–$Ni_{1-x}S$ and bornite solid solutions are present. Chalcopyrite solid solution coexists with the monosulfide solid solutions below 850°C and with α-NiS below 830°C.—MF

01555 **Craig, J. R.; Naldrett, A. J.** Minimum melting of nickeliferous pyrrhotite ores: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 417–419, illus., 1968.

Melting experiments have been performed on nickeliferous pyrrhotite ore with compositions containing 15–20 wt percent magnetite. Although minimum melting curves shift to lower S contents with 10 and 20 percent Ni, it is apparent that much Ni does not greatly lower melting temperatures below those in the Fe–S–O system; the presence of 2 percent copper lowers the melting temperature of nickeliferous pyrrhotite–magnetite mixtures 15°–20°C. The melting temperature at 10 and 20 percent nickel varies over a range of 50° to 60°C as sulfur content changes from about 36 to 39 percent in the monosulfide solid solution. These data indicate that the minimum temperatures at which nickeliferous pyrrhotite–magnetite ores may be emplaced as melts or crystal mushes varies between about 980° and 1040°C.—MST

01559 **Craig, J. R.; Naldrett, A. J.; Kullerud, G.** Succession of mineral assemblages in pyrrhotite-rich Ni-Cu ores: Carnegie Inst. Washington Yearbook 66, 1966-67, p. 431-434, illus., 1968.

Significant sulfide assemblages from these ores are chalcopyrite-cubanite-pyrrhotite-pentlandite and bornite-cubanite-pyrrhotite-pentlandite; magnetite is always present. The succession of assemblages through which typical ores have passed since injection or segregation is reconstructed. It is concluded that these assemblages result from a series of reactions occurring over a wide temperature range and represent partial re-equilibration to temperatures below 200°C. The concentration of S has a more pronounced effect on the succession than that of Ni and Cu.—ESL

01560 **Craig, J. R.** The Fe-Ni-S system—[Pt. 1] Violarite stability relations: Carnegie Inst. Washington Yearbook 66, 1966-67, p. 434-436, illus., 1968.

Violarite, often present in small amounts in iron-nickel sulfide ores, forms most often as a secondary mineral, but also occurs as a primary and principal ore mineral. Experimentation has demonstrated that violarite is stable to 461°±3°C; it was synthesized by reaction of sulfur and the appropriate Mss composition at 300° and 400°C. Synthesis of a homogeneous solid solution between violarite and polydymite was accomplished at 300°C by sulfurization of Mss compositions; polished sections of the result were studied.—ESL

Craig, J. R. *See* Naldrett, A. J. 01561

01562 **Craig, J. R.; Naldrett, A. J.; Kullerud, G.** The Fe-Ni-S system—[Pt. 3] 400°C isothermal diagram: Carnegie Inst. Washington Yearbook 66, 1966-67, p. 440-441, illus., 1968.

Results of new experimental data incorporated in the isothermal diagram of the Fe-Ni-S system at 400°C in the presence of vapor include the occurrence of the violarite solid solution, the coexistence of Ni_7S_6 and $(Fe,Ni)_9S_8$, and the presence of a homogeneous Mss phase spanning the system.—ESL

01530 **Crain, Ian K.** The glacial effect and the significance of continental terrestrial heat flow measurements: Earth and Planetary Sci. Letters, v. 4, no. 1, p. 69-72, illus., 1968.

The effect of the increase in land surface temperature at the end of the Wisconsin glaciation, in theory should be observable as a decrease in heat flow towards the surface. This trend is shown in Appalachian region heat-flow values tabulated by Lee and Uyeda (1965), where heat flow correlates positively with the depth of the borehole, having a linear correlation coefficient of 0.678. Adjustment of continental heat-flow observations for this effect would increase the continental average above the oceanic. In this way the large deep-seated lateral variations in temperature required to explain the present apparent equality are unnecessary. Similarly regional variation in mean heat flow may be in part due to different average borehole depth in the region.—*from* Author's abstract

01502 **Cramer, Fritz H.** Considérations paléogéographiques à propos d'une association de microplanctontes de la série gothlandienne de Birmingham (Alabama, U.S.A.) [abs.]: Soc. Géol. France Compte Rendu 1968, no. 1, p. 22, 1968.

07111 **Creer, K. M.** A synthesis of world-wide palaeomagnetic data, *in* Mantles of the Earth and terrestrial planets (S. K. Runcorn, editor): London and New York, Interscience Publishers, p. 351-382, illus., tables, 1967.

Geographic reconstruction of South America, Africa, Europe, North America, and Australia during Upper Paleozoic time is made from paleomagnetic data by superimposing the respective continental polar wandering curves. Contrary to earlier reconstructions, Australia appears to have been adjacent to Africa. No Paleozoic data are available for India and Antarctica. Deviation of individual Mesozoic polar wandering curves from the master Paleozoic curve suggests the time when the

supercontinents started to break apart. No tenable alternative is found to challenge the reality of drift.—JPF

07054 **Csallany, Sandor C.** The hydraulic properties and yields of dolomite and limestone aquifers [with French abs.], *in* Hydrology of fractured rocks—Dubrovnik Symposium, 1965, Proc., V. 1: Internat. Assoc. Sci. Hydrology Pub. 73, p. 120–138, illus., 1967.

About 1,250 well-production tests were made on more than 1,000 wells penetrating Mississippian, Silurian, and Ordovician dolomite or limestone formations in Illinois. Water-yield openings extend for considerable distances; dolomite and limestone contain numerous interconnected fractures and crevices. The controlled pumping test method may describe hydraulic properties of the dolomite and limestone on an areal basis, but does not accurately describe drawdown in the immediate vicinity of a pumped well. Statistical analysis of adjusted specific capacity data is probably the best and most practical method to determine yields of wells because of the interconnection of fractures and inconsistency in yields. Probable ranges in yields on undeveloped areas are estimated from specific capacity frequency graphs, aquifer thickness and areal geology maps, and water-level data.—*from* Author's abstract

06980 **Cuénod, Yves; Martini, Jacques.** On the presence of zeolite rocks in the Rio Chiriqui basin (western Panama) [with French abs.]: Soc. Physique et Histoire Nat. Genève Compte Rendu, new ser., v. 1, no. 3 (Archives Sci., v. 19, 1966 supp.), p. 152–158, illus., tables, 1967.

The authors describe a series of pyroclastic rocks in which zeolites are developed on a large scale. They identify two low-grade metamorphic facies: clinoptilolite-analcime and laumontite. The occurrence of wairakite and the presence of a batholithic intrusion suggest high temperature conditions. According to the authors, the pumpellyite-prehnite metagraywacke facies does not exist in contact metamorphism, the absence of the pumpellyite mineral and the intimate association epidote-laumontite found here thus being explained.—*from* Authors' abstract

01601 **Cullins, Henry L.** Geologic map of the Banty Point quadrangle, Rio Blanco County, Colorado: U.S. Geol. Survey Geol. Quad. Map GQ-703, scale 1:24,000, section, text, 1968.

Oil and gas, coal, oil shale, sodium zeolites, and sand and gravel occur within the Banty Point quadrangle, but only oil and gas and sand and gravel are exploited presently. Part of the Rangely oil field, with an ultimate recovery of 100 million bbl or more, is included within the mapped area; production is from several formations and reservoirs along the flanks and crest of a large anticline at depths from about 560 to >6,700 feet. Only the Mancos Shale and Weber Sandstone are presently productive; cumulative production through 1965 is tabulated. Coal beds from 4 to 12 feet thick are exposed in the coal members of the Mesaverde Formation. Oil shale and analcime are present in the Parachute Creek Member of the Green River Formation; oil yields range from 10–25 gals per ton; of the nine thin beds of analcime, the thickest is 1.4 feet.—MCM

Cumming, G. L. *See* Clowes, R. M. 01609

01633 **Currie, K. L.; Shafiqullah, M.** Geochemistry of some large Canadian craters: Nature, v. 218, no. 5140, p. 457–459, table, 1968.

Discovery of alkaline and carbonatite rocks in the Brent crater (1967) has thrown serious doubt on the petrographic criteria used to prove an impact origin of such structures. Four large Canadian craters have been examined by geochemical methods—East and West Clearwater, Carswell, and Manicouagan. The geochemical facts militate against a "pure" volcanic hypothesis and against a modified impact hypothesis in which impact triggers later volcanism. A third possibility is that alkaline solutions generated by ultramafic alkaline material melted the wall rocks at shallow depth below the crater floor producing an anatectic melt of mildly alkaline affinities. This theory explains the presence of ultramafic and mildly alkaline rocks in the same structure.—DBV

Cushing, E. M. *See* Boswell, E. H. 01510

Cutbill, J. L. *See* Banner, F. T. 07074

01234 **Cutbill, John L.** Technical and theoretical obstacles to construction of adequate classification of fusulinid Foraminifera [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 523, 1968.

07136 **Darrah, William C.** The structure of *Cardiocarpus florini* (Darrah), a Pennsylvanian cordaite seed from Iowa: Pennsylvania Acad. Sci. Proc., v. 40, no. 2, p. 80–86, illus., 1967.

Cardiocarpus florini (Darrah) n. comb. is redescribed to include new information on the detailed histology of the seed and assign the species to this form genus. The integuments, vascular system, nucellus, megaspore and micropyle are now fully known. The external features are also known in detail. The species is referred to the small-seeded *Cordaitales* of the *Cordaicarpus branneri* type (external form) and the *Mitrospermum* type (internal form). Since *Cardiocarpus florini* is known both internally and externally, nomenclatural procedures are complicated because different generic designations are applied to each aspect.—Author's abstract

01235 **Davies, David K.** Selective dispersal of quartz [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 523–524, 1968.

01454 **Davies, Peter J.; Till, Roger.** Stained dry cellulose peels of ancient and Recent impregnated carbonate sediments: Jour. Sed. Petrology, v. 38, no. 1, p. 234–237, table, 1968.

Dry cellulose peels made on etched and stained surfaces of carbonate sediments and rocks permit identification of the common carbonate minerals and show greater textural detail than thin sections. By using a series of several peels from a rock surface stained with Alizarin Red-S, potassium ferricyanide, Feigl's solution and Alizarin cyanine green, calcite, ferroan calcite, high magnesium calcite, aragonite, dolomite, and ferroan dolomite can be identified. Procedures and etching and staining times are given.—HEC

01394 **Davies, William E.** Engineering geology, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 80–96, illus., table, 1968.

A very generalized description of the engineering aspects of the various areas in Appalachia is given. Problems, such as karst, in each of the various physiographic provinces are described. The nature of the soil, the rock, structures in rock, landslides, and the like are described cursorily with the emphasis being placed upon the influence of these features on construction and other engineering problems.—HRC

01409 **Davies, William E.** Physiography, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 37–48, illus., table, 1968.

A very generalized, cursory review of the physiography of Appalachia is given. Each of the various physiographic provinces is defined, and the origin of the various landforms including caverns is given.—HRC

07082 **Davis, Emma Lou.** Man and water at Pleistocene Lake Mohave: Am. Antiquity, v. 32, no. 3, p. 345–353, illus., 1967.

For guidance of archeologists, simple criteria are outlined for distinguishing between sandblasting and waterwear of stone artifacts. Although ancient basalt tools found on the beaches of Pleistocene Lake Mohave, Calif., are sandblasted rather than waveworn, other evidence strongly indicates their contemporary association with a deep, permanent lake. Artifact assemblages and associated radiocarbon dates are inventoried for five other sites (Lind Coulee, Wash., and San Dieguito, Death Valley, Panamint Valley, and Borax Lake, Calif.), all situated beside then-existing marshes, streams, or lakes. Together they show that a widespread culture of the Lake Mohave

type existed in the western Great Basin about 7000 B.C. during a period of moister climate associated with final stands of a Pleistocene lake.—VMJ

Davis, G. L. *See* Krogh, T. E. 01585

01236 **Davis, Richard A., Jr.** "Canadian–Ozarkian" unconformity in upper Mississippi Valley [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 524, 1968.

Davison, W. L. *See* Blackadar, R. G. 01526

Davison, W. L. *See* Blackadar, R. G. 01527

Davison, W. L. *See* Blackadar, R. G. 01607

01660 **Dawes, Peter R.** Contrasted types of metamorphism of basic intrusions in the Precambrian basement of the Tasiussaq area, South Greenland: Medd. om Grönland, v. 185, no. 4, 47 p., illus., tables, 1968; *reprinted as* Grönlands Geol. Undersögelse Bull. 71, 1968.

Three distinct episodes of basic intrusion can be recognized in these Precambrian rocks: (1) the oldest, sills and dikes of pyriclasites and biotite–pyriclasites, (2) dikes of pyroxene–metadolerites, (3) dikes and small bodies of metagabbros, metadolerites, metanorites and amphibolites. For the Sanerutian pyroxene–metadolerites dipsenic conditions are suggested, inherited from Ketilidian granulitic facies metamorphism with only a brief hiatus. No palimpsest features remain in the oldest, severely changed intrusions; they were probably volcanic emplaced in geosynclinal sediments. Most rocks of the 2d episode are granular, and those of the 3d episode are ophitic to microporphyritic; both, emplaced into granitic and metamorphic rocks at a later stage, indicate trends in the crust toward brittle conditions, not cratogenic.—GDC

01628 **Dawson–Grove, G. E.; Palmer, K. R.** Take a practical approach to the use of computers in log analysis: Canadian Petroleum, v. 9, no. 5, p. 8–14, 16, illus., 1968.

For successful analysis of logs by computer, problems should be expressed logically and mathematically; a log specialist and a computer programmer are needed. Descriptions and examples of the Home Oil porosity/lithology programs involve simultaneous analysis of sonic, density, and neutron logs, testing for eight components. At present there are three separate Fortran IV programs for the IBM 1130 computer, known as the carbonate, sand–shale, and potash programs. Computer–derived lithology logs agree closely with drill cutting sample records and other available control. Computer analyses in general are only as good as the programs, components, and parameters put into them, and the raw data on which they operate.—ESL

07086 **DeCosta, John; Warren, Claude N.** Paleolimnology and prehistory: Am. Antiquity, v. 32, no. 1, p. 31–35, 1967.

Paleolimnologic studies applicable to archeology in North America and Europe are reviewed. Although paleolimnology has long been used by archeologists in a limited fashion, its potential in the reconstruction of paleoclimates has not been fully realized. Certain aquatic micro–organisms, notably cladocerans (branchiopod crustaceans) and diatoms, show a more rapid and subtle response to slight climatic changes than do the traditionally used pollen profiles. Influence of prehistoric man in modifying the normal development of a lake can sometimes be detected by study of the mineral sediments, organic materials, pollen, and micro–organisms. Paleolimnology may be useful in solving some of the major archeological problems in the arid southwestern U.S.—VMJ

Deevey, Edward S., Jr. *See* Tsukada, Matsuo. 07114

01237 **Dellwig, Louis F.; Evans, Robert.** Depositional processes in Salina salt of Michigan and New York [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 524, 1968.

01238 **Dickinson, Kendell A.** Clay-mineral facies in Upper Jurassic rocks in northeastern Texas and adjacent parts of Louisiana and Arkansas [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52,ino. 3, p. 524–525, 1968.

Dion, N. P. *See* Kaufman, M. I. 01488

01239 **Dixon, Mark A.** Fish otolith assemblage of gastrolithic beach gravel [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 525, 1968.

01485 **Doehring, Donald O.** The effect of fire on geomorphic processes in the San Gabriel Mountains, California: Wyoming Univ. Contr. Geology, v. 7, no. 1, p. 43–65, illus., tables, 1968.

During the summer, material normally slides from slopes into slope channels and areas of low relief when soil moisture and cohesion is low. During the winter, fluvial erosion scours the debris from the channels. In recent years, the amount of material moved into intermontane areas during the summer months far exceeds the amount removed from these areas during the winters. The high drainage density and lack of substantial intermontane deposits of alluvium and colluvium indicate the operation of a process other than normal erosion. A study of erosion following a fire in the San Dimas Forest shows that the fire-flood sequence has, in a short time, removed the products of 40 years of normal erosion.—*from* Author's abstract

07020 **Doehring, Donald O.; Clausen, Eric N.** The analysis of coarse clastic grains using standard statistical methods: Wyoming Univ. Contr. Geology, v. 6, no. 2, p. 87–92, illus., tables, 1967.

Analysis by direct measurement and least square statistics is advocated. Sieving produces errors and various problems which are described. A relatively small number of randomly-selected grains could be used. Calculations are trivial with a computer. Comparisons were made with standard sieving techniques, and the latter were found wanting as they could not distinguish between particles deposited in slightly different environments. The suggested approach permits gathering of all desired data in one operation, produces more accurate results, prompts the user to design well thought-out sampling schemes, and produces least square statistics useful for comparisons with other workers and equipment.—*from* Authors' abstract

01574 **Donnay, Gabrielle; Allmann, Rudolf.** The crystal structure of ardennite: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 485–487, illus., table, 1968.

The structure, solved by the symbolic addition procedure of Karle and Karle, is closely related to that of epidote but shows a novel feature: linear Si_3O_{10} groups, of symmetry 2 *mm*, with three tetrahedra on one side of the line of coplanar edges. In ardennite there are three independent octahedral chains along *b*, and only two in epidote. The 'mixed rings' of epidote are also found in ardennite. Any substitution of As and V, when present in amounts of more than two atoms per cell, take place in an isolated SiO_4tetrahedron.—ESL

Donnay, Gabrielle. *See* Kullerud, G. 01578

Donnay, Gabrielle. *See* Meyer, H. O. A. 01579

Donnay, Gabrielle. *See* Kullerud, G. 01580

Donnay, J. D. H. *See* Kullerud, G. 01578

Donnay, J. D. H. *See* Meyer, H. O. A. 01579

Donnay, J. D. H. *See* Kullerud, G. 01580

07056 **Donovan, D. T.; Hodson, F.; Howarth, M. K.; House, M. R.; Tozer, E. T.; Wright, C. W.** Mollusca—Cephalopoda (Ammonoidea), Chap. 15 *in* The fossil record—A symposium with documentation: London, Geol. Soc. London, p. 445–460, illus., 1967.

The range of 2 families, 40 superfamilies, and 1 suborder are documented, and a range chart is included.—ESL

01381 **Dorr, John Van N., 2d; Sweeney, John W.** Manganese, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 416–425, illus., table, 1968.

Manganese occurs as a residual oxide in the weathered zone throughout Appalachia, most being in the valley to the west of the Blue Ridge. A very brief description of its occurrence is given.—HRC

07089 **Dorwin, John T.** Iodine staining and ultraviolet photography field techniques: Am. Antiquity, v. 32, no. 1, p. 105–107, illus., 1967.

Two techniques for clarifying stratigraphy at archeological sites were briefly experimented with during excavation of a large mound near Newburgh, Ind. Iodine gas released from iodine crystals reacts with organic compounds, staining them dark brown; the gas was confined to a small layered profile, but at the end of 10 hours there was little differentiation of organic from inorganic materials; further experimentation is needed. A prepared profile in the mound was photographed at night using a reflected ultraviolet light source, having been photographed from the same points in daylight. Layering and areas of disturbed soil not obvious in daylight were revealed clearly by ultraviolet light, while some features obvious in daylight did not appear under ultraviolet light; complementary use of the two types of photography is indicated.—VMJ

Dowd, James. *See* Arndt, Harold H. 01396

07057 **Downie, C.; Fisher, D. W.; Goldring, R.; Rhodes, F. H. T.** Miscellanea, Chap. 24 *in* The fossil record—A symposium with documentation: London, Geol. Soc. London, p. 613–626, illus., 1967.

The order Conodontophorida is used here only because it represents the best available taxonomic framework for treating conodonts, and not because it has any phylogenetic value. The range of 4 families and 11 subfamilies in the order is documented, and a range chart is included.—ESL

01505 **Duguid, James Otto.** Refraction determination of water table depth and alluvium thickness: Geophysics, v. 33, no. 3, p. 481–488, illus., tables, 1968.

During an investigation of alluvium [in Wyoming] using a shallow refraction seismograph, time–distance curves obtained indicated two refraction interfaces. The shallower of the interfaces is the ground-water table, whose depth was obtained with an accuracy of ±10 percent. The deeper interface is either the surface of the bedrock or the base of the weathered zone on the bedrock. If this lower interface is the surface of the bedrock, the velocity of seismic waves in the weathered material will be considerably lower than if the interface is the base of the weathered zone. Using this criteria makes it possible to determine whether the seismic wave is refracted from the surface of the bedrock or the base of the weathered zone. Author's abstract

07021 **Duguid, James Otto.** A cross section of the alluvium and bedrock at the Laramie River in Laramie, Wyoming: Wyoming Univ. Contr. Geology, v. 6, no. 2, p. 119–121, illus., table, 1967.

A cross section of the Laramie River obtained by geophysical techniques and checked by a number of drill holes indicates that the alluvial deposits of the Laramie River are thinner than suggested by Leopold and Miller's work on alluvial valleys in Wyoming. Three alluvial terraces are present on the Laramie River. However, a more detailed analysis of units within the alluvium itself should be made before the names Kaycee, Moorcroft and Lightning are applied to the terraces of the Laramie River.—Author's abstract

01542 **Dundon, Robert; Lindsley, D. H.** Mössbauer study of synthetic Ca–Fe clinopyroxenes: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 366–369, illus., table, 1968.

The authors have applied Mössbauer absorption techniques to members of the hedenbergite–ferrosilite series in an attempt to estimate the relative Fe^{2+} populations in the M_1 and M_2 sites of the crystal structure. The positions of the absorption peaks, their widths, and the percentage of absorption are given in a table.—MST

Dunlop, G. M. *See* Ager, D. V. 07073

Durbin, Daniel R. *See* Ehmann, William D. 01514

07130 **Durham, J. Wyatt.** Camptostromatoids, *in* Treatise on invertebrate paleontology—Pt. S, Echinodermata 1, V. 2: New York, Geol. Soc. America (and Univ. Kansas Press), p. S627–S631, illus., 1967.

The class Camptostromatoidea Durham, 1966, has been established for the genus *Camptostroma*, a free-living, apparently medusaeform radially symmetrical (but not pentaradiate) echinoderm with marginal free arms and a concave oral surface. The genus had previously been assigned to various coelenterate classes by other authors, and was included in the Scyphozoa by H. J. Harrington (1956) in "Coelenterata", Pt. F *of* Treatise on invertebrate paleontology. *C. roddyi*, type species, occurs in the Lower Cambrian Kinzers Formation of Pennsylvania, associated with lepidocystoids. Cleavage and microstructure of original calcite plates confirm assignment to Echinodermata, probably Echinozoa. Distinctions from holothuroids and ophiocistioids are discussed.—VMJ

07131 **Durham, J. Wyatt.** Lepidocystoids, *in* Treatise on invertebrate paleontology—Pt. S, Echinodermata 1, V. 2: New York, Geol. Soc. America (and Univ. Kansas Press), p. S631–S634, illus., 1967.

Lepidocystoidea, a new class of Crinozoa, and Lepidocystidae, new family, are here proposed to accomodate the genus *Lepidocystis* Foerste, 1938. The single described species, *L. wanneri*, is known only from the Lower Cambrian Kinzers Formation, Pennsylvania, where a few crushed specimens occur with camptostromatoids (Echinozoa). Lepidocystoid specimens show an arched oral surface with numerous small plates with sutural pores, a circlet of free biserial arms, and an anal aperture. The aboral surface is elongate conical and covered with imbricating plates the animal may have lived upright on the sea floor with the apex imbedded in sediment.—VMJ

01531 **Dymond, Jack; Windom, Herbert L.** Cretaceous K–Ar ages from Pacific Ocean seamounts: Earth and Planetary Sci. Letters, v. 4, no. 1, p. 47–52, illus., table, 1968.

Potassium–argon dates were determined on mineral separates and whole rocks dredged from three seamounts southwest of the Hawaiian Islands. Biotite and hornblende ages indicate that two of the seamounts are at least 85–90 m.y. old. These ages suggest that if the sea-floor-spreading model is valid, the average rate of spreading since Cretaceous time cannot have been faster than the rate over the last 3 to 4 m.y. Whole-rock and feldspar ages from the seamount are 25 to 50 percent lower than the biotite and hornblende ages, demonstrating the effects of submarine alteration on argon retention. Comparatively recent volcanism (0.70 m.y.) was dated on one of the seamounts.—Authors' abstract

01432 **Dyni, John R.** Geologic map of the Elk Springs quadrangle, Moffat County, Colorado: U.S. Geol. Survey Geol. Quad. Map GQ-702, scale 1:62,500, sections, text, 1968.

Mineral resources of the Elk Springs quadrangle include oil and gas, coal, sand and gravel, and water; there has been some prospecting for uranium. Gas was discovered in Dakota Sandstone in the Elk Springs–Winter Valley field in the 1920's, but there was no production until discovery of oil in Weber Sandstone in 1946; cumulative production through 1965 was 506,202 bbl. Three coal zones in the Cretaceous Mesaverde Group have beds up to 11 feet thick. Gravel pits, chiefly

in basal conglomerate of the Browns Park Formation, have been opened for road construction; sand is abundant in the same formation and in alluvium of Yampa and Little Snake River valleys. Ground water is available in alluvium and in the Browns Park south and east of Cross Mountain at depths of several hundred feet.—MCM

07138 **Dyson, James L.** Geology and mineral resources of the southern half of the New Bloomfield quadrangle, Pennsylvania: Pennsylvania Geol. Survey Atlas 137cd, 86 p., illus., geol. map, 1967.

Bedrock consists of 17,000–20,000 feet of folded and faulted Ordovician–Mississippian sedimentary strata, cut by Triassic diabase dikes. The top 12,000 feet are nonmarine and are characterized by cyclic sedimentation. The Sherman Creek and Duncannon Members are proposed in the Catskill Formation to replace the Lower and Upper Redbeds and Upper Sandstone Members. The area lies in the Appalachian Mtn. and Great Valley sections of the Valley and Ridge province; the boundary between them is along Blue Mtn. Folds in the Great Valley are overturned to the north, and age of bedrock is pre–Silurian. Most of the area north of Blue Mtn. lies within the eastward plunging Cove syncline, and rocks are post–Ordovician. A geologic map, scale 1:24,000, accompanies the report, and an appendix contains eight measured sections.—ESL

Eames, F. E. *See* Banner, F. T. 07074

Eaton, R. W. *See* Hudnall, James S. 01221

01447 **Edge, Lyle N.; Boyer, Robert E.** Inexpensive realism in fossil study: Jour. Geol. Education, v. 16, no. 2, p. 71–72, illus., 1968.

The approach to making and studying fossils herein described was developed during a semester of In-Service Institute in Earth Science, University of Texas at Austin, as a modification of the plastic fossil kits, following recommendation by ESCP to use locally found fossils. Cretaceous mollusks of several types are to be found in the Austin area in classroom quantities; less abundant types were selected for reproduction by casting in a latex mold, which can be shaken and stretched to produce details and to remove air bubbles, then be reused indefinitely. Local finds must be supplemented by purchasing a few carefully selected types or by trading. Fossils of other ages or from other localities could be borrowed for comparison.—GDC

Edgerton, Curt D., Jr. *See* Cox, Dennis P. 01370

Edgerton, Curt D., Jr. *See* Meyer, Richard F. 01399

01514 **Ehmann, William D.; Durbin, Daniel R.** Silicon abundances in some meteorites and standard rocks by activation analysis: Geochim. et Cosmochim. Acta, v. 32, no. 4, p. 461–464, tables, 1968.

New analytical data for silicon in 18 meteorites and 8 standard rocks have been obtained by nondestructive fast neutron activation analysis. The new meteorite data together with the data of Vogt and Ehmann (1965) are used to compute mean silicon abundances among the chondrite classes of Van Schmus and Wood (1967). Authors' abstract

Ehrlich, Robert. *See* Ferm, John C. 07063

Ehrlich, Robert. *See* Ferm, John C. 07097

Eilertsen, Nils A. *See* Newman, William L. 01326

Eilertsen, Nils A. *See* Herz, Norman. 01367

Eilertsen, Nils A. *See* French, Alice E. 01388

01240 **El-Baz, Farouk.** Coprolites versus fecal pellets [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 526, 1968.

07103 **Elder, J. W.** Thermal turbulence and its role in the Earth's mantle, *in* Mantles of the Earth and terrestrial planets (S. K. Runcorn, editor): London and New York, Interscience Publishers, p. 525–547, illus., 1967.

The problem of formulating a dynamic model of the mantle is discussed in order to determine the theoretical difficulties encountered in even the simplest models and to suggest models for further investigation. Non-steady convective motions found in strongly unstable systems are outlined and considered in relation to the Earth's mantle by means of a sequence of simple models. Emphasis is placed on features that call for time-varying phenomena. A preliminary report is given of laboratory observations of thermal turbulence in a fluid with a large Prandtl number.—JPF

Elliott, G. F. *See* Ager, D. V. 07073

Ellis, Charles W. *See* Tillman, Roderick W. 01202

01207 **Ellis, Charles W.** Recent carbonate sedimentation and diagenesis in Walker Cay–Grand Cays area, Little Bahama Bank [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 526, 1968.

01639 **Ellitsgaard-Rasmussen, K.** Mineralefterforskningens stade i Grönland 1968: Grönland 1968, no. 4, p. 97–110, illus., 1968.

Interactions and applications of the essentials of a mineral exploration program to conditions in Greenland are somewhat unique. Prospecting can be done by private companies or by the Grönlands Geologiske Undersögelse (GGU); a company obtaining a monopoly for exploration in an area has free access to geological information from the GGU, which, in turn, can carry out geological mapping in that area. Details of agreements between companies and the GGU are outlined; a map shows concessions. Recent interest has been on coal, oil, and natural gas at Nugssuaq and Disko; several areas indicate possibilities of new mineral finds. Field operations, limited to about three months per year, are supplemented by laboratory work in chemistry and mineralogy. The GGU plans to prepare geologic maps for all Greenland, a project estimated to require about 200 years.—MCM

Emslie, R. F. *See* Lindsley, D. H. 01572

England, J. L. *See* Kullerud, G. 01563

England, J. L. *See* Meyer, H. O. A. 01589

England, J. L. *See* Bell, P. M. 01590

01385 **Ericksen, George E.; Thomson, Robert D.** Lime, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 225–227, illus., table, 1968.

An extremely brief description of the origin and occurrence of limestone and dolomite suitable for making lime is given; no new data are included.—HRC

01386 **Ericksen, George E.; Cox, Dennis P.** Limestone and dolomite, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 227–252, illus., tables, 1968.

In these brief but complete descriptions of the limestone and dolomite sources in Appalachia, the emphasis is placed upon their use as construction material. Chemical analyses are included, as is extensive tabular data.—HRC

01400 **Ericksen, George E.; Thomson, Robert D.** Cement, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 163–167, illus., tables, 1968.

A cursory review of the types of cement-making materials available in Appalachia is given; no new data are included.—HRC

Ericksen, George E. *See* Laurence, Robert A. 01410

07109 **Ernst, T.** Olivine nodules and the composition of the Earth's mantle, *in* Mantles of the Earth and terrestrial planets (S. K. Runcorn, editor): London and New York, Interscience Publishers, p. 321–328, illus., 1967.

Assuming that olivine nodules represent mantle material consisting of peridotitic layers within the Earth, assimilation by basaltic magma should be indicated by a scatter in chemical, normative, or Niggli values. The fabric of the nodules suggests a metamorphic origin. The problem of origin should be resolved by geochemical data, especially the distribution of elements in different phases of basalts and inclusions.—JPF

Evans, Robert. *See* Dellwig, Louis F. 01237

01208 **Eyer, Jerome A.** Phylogeny and ontogeny of Charophyta [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 526–527, 1968.

07123 **Fay, Robert O.** Edrioblastoids, *in* Treatise on invertebrate paleontology—Pt. S, Echinodermata 1, V. 1: New York, Geol. Soc. America (and Univ. Kansas Press), p. S289–S292, illus., 1967.

The class Edrioblastoidea Fay, 1962, is based on a single specimen of primitive attached crinozoan which was formerly classified variously with blastoids, cystoids, or edrioasteroids. *Astrocystites ottawaensis* is from the Middle Ordovician of Canada. The theca superficially resembles those of blastoids and parablastoids. Only the top of the column is preserved. Brachioles are lacking; the ambulacral pores apparently were passageways for tube feet as in edrioasteroids. The large thecal plates have distinctive broad, deep infolds that tend to cross plate sutures at right angles; these seem entirely unrelated to cystoid pore rhombs or blastoid hydrospires. Possibly edrioblastoids gave rise to blastoids; conjectural evolutionary changes are outlined.—VMJ

07124 **Fay, Robert O.** Parablastoids, *in* Treatise on invertebrate paleontology—Pt. S, Echinodermata 1, V. 1: New York, Geol. Soc. America (and Univ. Kansas Press), p. S293–S296, illus., 1967.

The class Parablastoidea Hudson, 1907, comprises stem-bearing crinozoans with blastoid-like theca having well developed pentameral symmetry and stellate appearance in oral view. A single family, Blastocystidae, consists of two genera, each with one species. *Blastoidocrinus* is a rather well-known form from lower Middle Ordovician of New York and Quebec; a poorly known form is reported from USSR. The oral side of the theca is characterized by a thick apical plate at the summit, interradial deltoid plates, radial subpetaloid ambulacra, parallel biserial brachioles packed closely together along the sides of the distal wing plates in the middle of each ambulacrum. The parablastoids are thought to be not closely related to either edrioblastoids or blastoids.—VMJ

Fay, Robert O. *See* Beaver, Harold H. 07125

Feitler, Stanley A. *See* Lesure, F. G. 01327

Feitler, Stanley A. *See* Weis, Paul L. 01368

Feitler, Stanley A. *See* Kinkel, Arthur R., Jr. 01378

Feldmann, Rodney M. *See* Miller, Barry B. 01433

07061 **Fell, H. Barraclough.** Echinoderm ontogeny, *in* Treatise on invertebrate paleontology—Pt. S, Echinodermata 1, V. 1: New York, Geol. Soc. America (and Univ. Kansas Press), p. S60–S85, illus., 1967.

Known larval taxonomy is presented for extant families of Crinozoa, Asterozoa, and Echinozoa. Indirect development (bilaterally symmetrical larva) is predominant only in Echinoidea. Convergent patterns of development in some ophiuroids, crinoids, and holothuroids, which all have vitellaria larva, and divergent patterns in ophiuroids, which include the bilaterally symmetrical larva, the vitellaria, and no larva, show that phylogeny cannot be interpreted from the larval stages. However, postlarval growth gradients of major skeletal elements and the hydrocoel do provide a basis for orderly evolutionary sequence, with homologs in extant and fossil forms. Asterozoa, with divergent radial patterns of growth, are derived from Crinoidea; Echinozoa, with meridional patterns, are derived from a more ancient globoid pelmatozoan stock and cannot be closely related to Asterozoa.—VMJ

Fenton, M. Brock. *See* Churcher, C. S. 01493

07063 **Ferm, John C.; Ehrlich, Robert.** Petrology and stratigraphy of the Alabama coal fields, *in* A field guide to Carboniferous detrital rocks in northern Alabama—Geol. Soc. America, Coal Div., 1967 Field Trip: University, Ala., Alabama Geol. Soc., p. 11–15, illus., 1967.

Carboniferous rocks overlying the Bangor Limestone are part of a clastic wedge. Most of the coarse-grained sediments are typical low-rank graywacke. The finer sediments are similar mineralogically except that they contain more illite and less kaolinite. Overall, the quartz content diminishes from north to south, and a southern source is postulated. The term "upper Pottsville" is used for those rocks with economical coal beds and considerable sandstone; the "lower Pottsville" contains fewer and thinner sandstones and fewer thick coal beds. The lower part of the "lower Pottsville" is more sandy and has different names in the different basins. The base contact with the Mississippian is gradational. Mississippian detrital rocks are finer grained. All the detritals of the region are from a prograding delta.—HRC

07097 **Ferm, John C.; Ehrlich, Robert; Neathery, Thornton L.** A field guide to Carboniferous detrital rocks in northern Alabama—Geol. Soc. America, Coal Div., 1967 Field Trip: University, Ala., Alabama Geol. Soc., 101 p., illus., tables, 1967.

This contains seven articles (cited separately) of a general nature about the material to be seen on a two day field trip. The trip is about 165 miles long and makes six stops: (1) Mississippian–Pennsylvanian section, (2) the Hyatt's Gap section, Mississippian shoreline facies, (3) Altoona Mountain section, Pottsville Formation, (4) Sequatchie anticline, Mississippian–Pennsylvanian boundary rocks, (5) the Warrior section, Pennsylvanian rocks, and (6) the Morris section, "delta front" sediments in the Pottsville Formation.—HRC

06986 **Ferráes, Sergio G.** Statistical analysis of time-intervals of successive earthquakes in Mexico City [also Spanish text]: Geofísica Internac., v. 7, no. 2, p. 43–52, illus., tables, 1967.

Observed distribution of frequency of occurrence *vs.* amplitude of time-intervals between any two successive earthquakes in Mexico City, with magnitude 3.5 and above, is studied in search of a formula expressing the frequency-amplitude relation. To test random occurrence the Poisson's distribution is discussed. It is shown that two types of theoretical functions have the required form to fit the observed frequency: a generalized exponential law, and a semi-logarithmic curve. It is concluded that we have a non-random occurrence; therefore, it appears that strong earthquakes in Mexico City are caused by correlated tectonic processes. After a strong earthquake has occurred, the expectation time-interval for a new earthquake is from one day to 48 days.—*from* Author's abstract

06970 **Feth, J. H.** Natural contamination hazards in arid basins, *in* Groundwater development in arid basins—Symposium, Utah State Univ., 1967, Proc.: Logan, Utah, Utah State Univ., p. 21–35, illus., table, 1967.

Naturally occurring chemical substances that are possible contaminants of ground water are discussed and examples from the Great Basin are cited. Ground-water quality is reviewed, including occurrence of brines. The questions of why there

is so much ground water of tolerable to good chemical quality in arid-basin aquifers, and to what extent these resources are renewable are largely unanswered. Sources of contamination in the atmosphere, lithosphere, hydrosphere, and biosphere are discussed. Remaining areas of ignorance, in which work should be done are mentioned.—ESL

01649 **Fierstine, Harry L.; Applegate, Shelton P.** Billfish remains from southern California with remarks on the importance of the predentary bone: Southern California Acad. Sci. Bull., v. 67, pt. 1, p. 29–39, illus., tables, 1968.

Fossil fishes of Istiophoridae (marlins, spearfishes, etc.) are rare in North America and previously unreported from western U.S. Fragmentary remains are here described from southern California: Istiophoridae undet. gen., second abdominal vertebra from middle Miocene of Kern County, and anterior caudal vertebra from late Pleistocene of Orange County; *Makaira* sp., bill fragment and a complete predentary bone from late Miocene of Orange County. Exact identification is impossible because of paucity of fossil and recent comparative material. The predentary bone of Istiophoridae is a neomorph, since it is not found in any ancestral or closely related teleost. The function of the predentary may be to strengthen the narrow symphyseal joint; its comparative size in istiophorid species may have taxonomic significance.—VMJ

Finger, G. C. *See* Bradbury, J. C. 01518

Finks, Robert M. *See* New York State Geological Assoc. 01401

01407 **Finks, Robert M.** Taconian Islands and the shores of Appalachia, Trip E *in* Guidebook to field excursions—New York State Geol. Assoc., 40th Ann. Mtg., Flushing, N. Y., 1968: Brockport, N. Y., State Univ. Coll., Dept. Geology, p. 117–153, illus., 1968.

Cambrian, Ordovician, Silurian, and Devonian rocks are preserved as inliers resting upon Precambrian rocks in the Highlands of northern New Jersey and adjacent New York. The formations are described in considerable detail in preparation for a field trip. A road log from New York City to the area covers 105 miles and makes 7 stops, each observing a different rock type or structure. Eight additional pages of text are added as an appendix.—HRC

Fish, George E., Jr. *See* Adams, John W. 01364

Fish, George E., Jr. *See* Wright, Wilna B. 01380

Fish, George E., Jr. *See* Withington, C. F. 01383

Fisher, D. W. *See* Downie, C. 07057

01674 **Fisher, William L.** Depositional systems in the Wilcox Group of Texas and their relationship to occurrence of oil and gas [abs.]: South Texas Geol. Soc. Bull., v. 9, no. 5, p. 1, 1968.

01450 **Fitzgerald, E. L.** Structure of British Columbia Foothills, Canada: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 4, p. 641–664, illus., 1968.

The Foothills between Peace and Liard Rivers comprise an elongate fold belt containing sedimentary rocks mainly of Mississippian, Triassic, Jurassic, and Late Cretaceous ages. Most exposures belong to the Gething–Debolt structural-stratigraphic unit. The upper part of this unit shows curvilinear and box and cuspate fold profiles, the central part has deformed passively, and the lowest part tends to show angular fold profiles and faults. Zigzag en echelon patterns predominate in the fold belt and become more complex in the north. Fold amplitude and wave length decrease northward.—WLA

01342 **Fleisher, Penrod Jay.** Glacial geology of the Big Pine Drainage, Sierra Nevada, California [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 8, p. 3336B–3337B, 1968.

01209 **Flemal, Ronald C.** Sespe Formation—Example of arid climate redbed [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 527, 1968.

01343 **Fletcher, Raymond Charles.** A finite amplitude model for the emplacement of gneiss domes and salt domes [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 8, p. 3337B, 1968.

Floyd, Jack C. *See* Hatfield, Craig B. 01469

Forbes, M. J., Jr. *See* Winner, M. D., Jr. 01625

Fountain, R. C. *See* Brooks, H. K. 07088

06974 **Freedman, Jacob.** Geology of a portion of the Mount Holly Springs quadrangle, Adams and Cumberland Counties, Pennsylvania: Pennsylvania Geol. Survey, 4th ser., Prog. Rept. PR 169, 66 p., illus., tables, geol. map, 1967.

The principal problem in the quadrangle is whether South Mtn. is an anticline or an overthrust block. The quadrangle is underlain by metamorphosed Precambrian volcanics and Cambrian clastics and carbonates. Downfaulted against the Precambrian are Triassic sandstones and conglomerates, cut by diabase and basalt dikes up to 110 feet thick. Rocks have been metamorphosed to the green schist facies. South Mtn. anticlinorium is a salient along the axis of greatest curvature in the Appalachian belt. The oldest rocks have been pushed northwest in doubly plunging folds; 14 first order, and a number of second order have been identified. There is possible evidence for more than one deformation, all postdating deposition of Lower Cambrian sediments. The northwest edges of Piney Mtn. and Trent and Trench Hills are considered to be part of the Reading Branch thrust. A number of high-angle faults occur also.—ESL

01210 **Freeman, Tom.** Operational classification of unconformities [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 527, 1968.

01329 **French, Alice E.** Gem-stone, mineral, and fossil collecting, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 288–303, illus., table, 1968.

Locations for mineral, gem, and fossil collecting are given in tabular form by state and county. Included also is a bibliography of references to the various publications available on localities.—HRC

01388 **French, Alice E.; Eilertsen, Nils A.** Abrasives, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 261–268, illus., tables, 1968.

In a cursory description of the occurrence of abrasives in Appalachia, emery, garnet, tripoli, and quartz, and corundum are discussed. No new data are included.—HRC

01389 **French, Alice E.; Stansfield, Robert G.** Asbestos, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 268–270, illus., 1968.

An extremely cursory description of the occurrence of asbestos in Appalachia is given. North Carolina is the chief source in the region. A brief description of the main deposits is given.—HRC

Frendzel, Donald J. *See* Cornwall, H. R. 01377

Frendzel, Donald J. *See* Maxwell, Charles H. 01387

Frendzel, Donald J. *See* Arndt, Harold H. 01396

01211 **Frey, M. G.; Grimes, W. H.** Bay Marchand-Timbalier Bay-Calliou Island salt complex, Louisiana [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 527, 1968.

01224 **Fuller, J. G. C. M.; Porter, J. W.** Petroleum reservoirs among evaporitic rocks of western Canada and northern United States [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 527, 1968.

01344 **Furlong, Robert Burton.** An electron diffraction and micrographic study of the high temperature changes in the clay minerals [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 8, p. 3337B–3338B, 1968.

01617 **Gabelman, J. W.; Krusiewski, S. V.** Regional metallotectonic zoning in Mexico: Soc. Mining Engineers Trans., v. 241, no. 1, p. 113–128, illus., 1968.

Regional metallogenic zones and areas of equal paragenetic range have been interpreted from a compiled metallogenic map of Mexico. Mineralization gradients of the pattern extend inland from coastal zones of high-temperature mineralization to a central longitudinal zone of relatively low-temperature mineralization. The striking regional pattern can be correlated with regional deformation gradients of similar position and orientation representing at least three major orogenic cycles in two structural belts. Paleozoic structural belts existed along each coast with deformation gradients diminishing inland toward a narrow, central peninsular craton. The Mesozoic-Tertiary Mexican belt covered the entire country with a gradient oriented toward the Gulf of Mexico. Most ore deposits in this belt are of Tertiary age. Mineralization gradients can be used to identify the regions most favorable for the occurrence of selected metals.—*from* Authors' abstract

07025 **Gabrielse, H.** Geology, Watson Lake, Yukon Territory: Canada Geol. Survey Prelim. Ser. Map 19-1966, scale 1:253,440, text, 1967.

The geologic sequence in Watson Lake area includes igneous and sedimentary rocks of Proterozoic through Mississippian age and steeply dipping Paleocene or Eocene sediments containing some lignitic coal. The entire area was covered by one or more advances of ice. Structural information is fragmentary and no coherent picture of style of bedrock formations has been obtained. A lead-zinc showing has been discovered and presence of scheelite has been reported.—MCM

01225 **Gagliano, Sherwood M.; Ho, Clara.** Physical and chemical properties of Mississippi River alluvial valley and delta clays [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 527–528, 1968.

Gallo, Phillip A. *See* Arndt, Harold H. 01396

01620 **Gardner, R. D.; Pincus, H. J.** Fluorescent dye penetrants applied to rock fractures: Internat. Jour. Rock Mechanics and Mining Sci., v. 5, no. 2, p. 155–158, illus., 1968.

Under ultraviolet illumination, nonparticulate fluorescent dye penetrants clearly mark the surface traces of fractures in minerals and rocks. This paper outlines the fluorescent penetrant method as used in a series of experiments concerned with studying the generation and propagation of extension fractures in flexed specimens of a porphyritic granite. Photographs taken before and after deformation are presented and from these the pattern of fracture development can be studied. Fracture traces down to 0.05 mm wide have been observed and photographed. This technique is applicable to other rock types in a variety of laboratory situations and its possible use in *in-situ* studies is now being investigated.—*fJm* Authors' abstract

06958 **Gartner, Stefan, Jr.; Smith, Lee A.** Coccoliths and related calcareous nannofossils from the Yazoo Formation (Jackson, late Eocene) of Louisiana: Kansas Univ. Paleont. Contr.—Paper 20, 7 p., illus., 1967.

Coccoliths, discoasters, and related calcareous nannofossils have been studied commonly using light microscopes and electron microscopes, but the results from the two techniques often have been impossible to relate. In order to test the feasibility of combining the best features of both, an assemblage from a late Eocene sample was studied intensively using a light microscope together with an electron microscope. Of 15 species in the assemblage, three are described as new. In addition,

different pseudointerference figures of placoliths are considered to be a reliable basis for specific distinctions, whereas size of the placoliths and the degree of development of some rhabdoliths are not considered taxonomically important.—Authors' abstract

01533 **Garza, Sergio.** Water-delivery study, lower Nueces River valley, Texas: Texas Water Devel. Board Rept. 75, 65 p., illus., tables, 1968.

Water released to the river from Lake Corpus Christi flows 35 mi to a lake behind Calallen Dam. Water is lost along much of the stretch and also increases in mineralization. The river is entrenched into a flood plain from 1/2 to 8 mi wide; 37 test holes were drilled in this alluvium. The shallow ground water in the alluvium is in hydraulic continuity with the river, which loses water to the alluvium or gains water from it depending mainly on the river stage. Part of the increase in mineralization is due to contamination by waste waters from oil-field and gravel-washing operations, and part to poor-quality ground water in the alluvium.—ESL

07108 **Gast, P. W.** Isotopic composition of lead in oceanic volcanic rocks—Evidence for chemical heterogeneity of the mantle [abs.], *in* Mantles of the Earth and terrestrial planets (S. K. Runcorn, editor): London and New York, Interscience Publishers, p. 319, 1967.

Gastner, Manfred. *See* Quakernaat, Joost. 01460

01654 **Gaucher, E. G.** Magnetic properties and gravity of selected anomalies, *in* A preliminary study of the Moose River belt, northern Ontario: Canada Geol. Survey Paper 67-38, p. 12-36, illus., 1968.

Ground magnetometer surveys totaling about 5,000 stations were carried out, remanent magnetization was studied, gravity profiles were run across structures, and 1,000 density determinations were completed on rock samples in a study of 13 aeromagnetic anomalies in northeastern Ontario. Two distinct anomalies in the Fraserdale area are probably caused by a gabbro body and a magnetite-bearing belt of gneisses. In the Moose River map-area, wide linear magnetic anomalies have been found to correspond to magnetite-bearing granulites. Magnetite-bearing rock and granulites have been found under two other anomalies, and pyroxenite, diabase dikes, and serpentinite explain four others. Causes of the Kapuskasing gravity high and a magnetic gradient west of Kapuskasing were not found.—ESL

01508 **Geis, Fred, Jr.** Old Faithful—A physical model: Science, v. 160, no. 3831, p. 989-990, illus., 1968.

The recent confirmation of a prediction that relates the duration of eruption to time between eruptions suggests a physical model of the internal cavity of Old Faithful.—Author's abstract

Geological Society of Kentucky. *See* Ohio Geological Society. 01332

01497 **George, T. Neville.** University geology—National systems compared: Geotimes, v. 13, no. 3, p. 10-12, table, 1968.

The various geology courses emphasized in different countries is in part a reflection of varying national assumptions in educational theories. Elements compared here among French, English, German, Communist countries, and American and Canadian systems are: public school background in geology, age of entrants to universities, undergraduate courses, duration, required field work and industrial experience, postgraduate studies, diplomas and degrees, emphasis on research, and technical application.—GDC

01672 **Geul, J. J. C.** Devon township, District of Thunder Bay: Ontario Dept. Mines Prelim. Geol. Map P. 466, scale 1 in. to 1/4 mi., text, 1968.

Large areas in Devon township are underlain by erosional remnants of diabase sheets which rarely exceed 100 feet in thickness and form cappings over gently folded Rove sediments. The diabase is structurally heterogeneous and forms at least two sill-like bodies separated by Rove sediments. The capping diabase dips southward at

angles of 2–8°, the dip increasing towards the south. Two linear trends predominate, striking N. 70° E. and N. 20° W. No horizons favorable for syngenetic mineralization have been detected. A geochemical survey could be considered for low-lying areas underlain by Rove sediments.—MCM

01673 **Geul, J. J. C.** Pardee township and Stuart location, District of Thunder Bay: Ontario Dept. Mines Prelim. Geol. Map P. 467, scale 1 in. to 1/4 mi., text, 1968.

A set of northeast-trending dikes, mainly olivine diabase and transecting flat-lying Rove sediments, runs through the southern half of Pardee township and Stuart location, giving rise to conspicuous linears. The diabase sheets, forming typical mesas and locally buttes and cuestas, are about 75–125 feet thick; they dip gently southwards at angles of 2–8°, the dip increasing from north to south. Mineralization of economic interest consists of copper-nickel associated with anorthositic gabbro, sulfides associated with the dikes, and miscellaneous sulfide occurrences.—MCM

01457 **Gibbs, Ronald J.** Clay mineral mounting techniques for X-ray diffraction analysis—A discussion: Jour. Sed. Petrology, v. 38, no. 1, p. 242–244, 1968.

Suction of slurry onto ceramic tile, smearing on glass slides, and dry powder pressing are considered to be the only acceptable methods of avoiding mineralogic segregation in preparing oriented clay specimens for X-ray analysis.—HAT

01667 **Giblin, P. E.** Hornepayne sheet, Districts of Algoma and Cochrane: Ontario Dept. Mines Prelim. Geol. Map P. 476, scale 1 in. to 2 mi., 1968.

Gilbert, F. P. *See* Popenoe, Peter. 01426

Gilbert, F. P. *See* Popenoe, Peter. 01427

01545 **Gilbert, M. C.** X-ray properties of jadeite–acmite pyroxenes: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 374–375, illus., 1968.

The author has determined the cell parameters of synthetic jadeite–acmite pyroxenes, which are important constituents of blue-schist and eclogite facies of rocks. Substitution of Fe^{3+} for Al in these pyroxenes appears to be random, with no measurable excess volume of mixing.—MST

Gilbert, M. C. *See* Richardson, S. W. 01548

Gilbert, M. C. *See* Wones, D. R. 01551

07062 **Girdler, R. W.** The world rift system and its bearing on possible processes in the mantle, *in* Mantles of the Earth and terrestrial planets (S. K. Runcorn, editor): London and New York, Interscience Publishers, p. 483–488, illus., 1967.

The world rift system, most of which is located near the centers of ocean basins, often changes direction and is associated with a ridge or rise several thousand kilometers wide. Translational and rotational crustal movements are associated with the rifting. The supposed character of mantle convection currents suggests that the rift system is located over and connects areas of rising convection. The location of the rift system and supplementary satellite gravity data suggest that there are at least four areas of rising convection.—JPF

07104 **Girdler, R. W.** A review of terrestrial heat flow, *in* Mantles of the Earth and terrestrial planets (S. K. Runcorn, editor): London and New York, Interscience Publishers, p. 549–566, illus., tables, 1967.

Comparison of heat flow over large regions of the Earth's surface requires statistical techniques which reduce the effect of localized high values. Both logarithmic normal and normal values should be examined over regions that cover a variety of geological and physiographic provinces. Mean values for all continental areas are higher than the corresponding means for all oceanic areas. Current analysis supports the hypothesis that undulations of the geoid are due to temperature differences in the mantle.—JPF

01226 **Girdley, W. Arch.** *Komia* banks (Pennsylvanian) of southwestern San Juan Mountains, Colorado [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 529, 1968.

07134 **Glaeser, J. Douglas.** Bedding-plane slips, wedge faulting and facies changes in the Parryville syncline, Carbon County, Pennsylvania: Pennsylvania Acad. Sci. Proc., v. 40, no. 2, p. 95–98, illus., 1967.

Internal structural and stratigraphic complexities within the Parryville syncline are exposed in the 100–160 foot high, nearly continuous cuts 4,400 feet long on Lehigh River at Parryville. Asymmetrically folded lower Catskill rocks are telescoped by bedding-plane slip and duplicated by wedge faulting. Prominent, abrupt facies changes in both rock type and color complicate analysis of structures in this folded, alternating competent and incompetent sequence. Bedding-plane slip and wedging appear to be two stages of the syncline development suggesting that both prefold sliding and compressional movements affected these rocks.—Author's abstract

Glancy, Patrick A. *See* Rush, F. Eugene. 07115

Gnauck, F. R. *See* Banks, H. P. 07070

01602 **Godwin, Larry H.** Geologic map of the Chair Mountain quadrangle, Gunnison and Pitkin Counties, Colorado: U.S. Geol. Survey Geol. Quad. Map GQ-704, scale 1:24,000, sections, text, 1968.

Coal is the only economic mineral deposit currently known in the Chair Mountain quadrangle. Anthracite and bituminous coal in the lower Mesaverde Formation crops out around the northern flank of the Ragged Mtn. laccolith and a thin discontinuous bony coal bed at the base of the Wasatch Formation crops out along Muddy Creek; except for a 7-ft bed, exposed beds are less than 3.5 feet thick. Alluvial gravels, containing basalt and quartz monzonite porphyry, have been used for road metal. A thick stratigraphic sequence, including Mancos Shale, Dakota Sandstone, Morrison Formation, and Entrada Sandstone, is present in the subsurface. An erosion surface at the Entrada's base cuts across Paleozoic and Precambrian rocks to the east, but the extent of Paleozoic rocks in this quadrangle is not known.—MCM

01532 **Goldberg, Edward D.** Ionium/thorium geochronologies: Earth and Planetary Sci. Letters, v. 4, no. 1, p. 17–21, illus., table, 1968.

Rates of sedimentation in the Pacific, Indian, and Arctic Oceans as determined by magnetic reversal studies appear to be in accord with those based upon ionium/thorium geochronologies when comparisons are made on a regional basis. The correction factors of Ku, et al, applied to ionium/thorium measurements on the assumption of the Lamont workers of a constant rate of accumulation for the last several hundred years in these pelagic deposits disregards the coarser:fine structure in the ionium/thorium depth profiles.—Author's abstract

Goldring, R. *See* Downie, C. 07057

01227 **Goldsmith, Louis H.** Considerations regarding formation of potash deposits [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 529, 1968.

Goles, Gordon G. *See* Gordon, Glen E. 01513

Gonthier, Joseph B. *See* Rosenshein, J. S. 01489

01513 **Gordon, Glen E.; Randle, Keith; Goles, Gordon G.; Corliss, John B.; Beeson, Marvin H.; Oxley, Susanna A.** Instrumental activation analysis of standard rocks with high-resolution γ-ray detectors: Geochim. et Cosmochim. Acta, v. 32, no. 4, p. 369–396, illus., tables, 1968.

Instrumental neutron activation analysis with high-resolution lithium-drifted germanium detectors was used to determine 23 elements in a wide variety of igneous rocks. Elements determined include almost all alkalines, many lanthanides and

transition elements, and several strongly lithophilic trace elements which are useful as indices of geochemical differentiation. Data are reported for six USGS standard rocks, a subalkaline abyssal basalt, and a rhyolite obsidian. Among the significant trends indicated by elemental ratios for these rocks are increases in K:Cs and Ba:Cs with differentiation, and Zr:Hf ratios in whole rocks which are lower than those previously observed in zircon separates. Possible extensions and improvements of the technique, which can lead to the determination of at least six additional elements, are discussed.—*from* Authors' abstract

Graham, S. F. *See* Butler, P. M. 07055

01655 **Granger, Harry C.** Localization and control of uranium deposits in the southern San Juan basin mineral belt, New Mexico—An hypothesis, *in* Geological Survey research 1968, Chap. B: U.S. Geol. Survey Prof. Paper 600-B, p. B60-B70, illus., 1968.

The Late Jurassic Morrison Formation contains primary uranium deposits along the southern margin of the San Juan basin in a belt about 80 by less than 10 miles. Known deposits seem to be directly beneath or closely downdip from areas where structurally uptilted edges of the Morrison sandstones were exposed at the paleosurface by Early Cretaceous erosion. Primary deposits are coextensive with a carbonaceous residue presumably derived by solution from decaying vegetal matter. It is speculated that soluble carbonaceous material was carried downward into the exposed Morrison sandstones by meteoric water and precipitated at the water table. Because of the probability that the carbonaceous material was not coprecipitated with the uranium but later accumulated uranium from ore-bearing solutions which permeated the rocks, the position of the carbonaceous residue constitutes a primary control of ore.—*from* Author's abstract

Grauch, Richard I. *See* Wise, Donald U. 07119

Grey, Richard R. *See* Adamson, Lucas G. 07039

01228 **Grieve, R. O.** Upper Devonian reef oil field—Redwater, Alberta, Canada [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 529-530, 1968.

Grimes, W. H. *See* Frey, M. G. 01211

06991 **Grivel, F.** Regional notes—Anomalies of the mean sea level at Acapulco, Gro., Mexico [also Spanish text]: Geofísica Internac., v. 7, no. 2, p. 53-61, illus., tables, 1967.

The Acapulco earthquakes of May 1962 constituted a cluster of seisms epicentered offshore near that port within a small area of the Acapulco Trough, where a great number of periodically active epicenters exist. Tsunamis appeared on May 11 and 19; their 30-minute oscillations, shown on graphs, are compared with prediction in earlier regular tide curves. In July there were more anomalies in sea level. For each month in the periods 1952-60 and 1963-66, mean sea-levels were tabulated; comparative graphs of daily variations at several Pacific coast sites for 1961, 1962, and 1963 show a definite anomaly for Acapulco. It is concluded there was an uplift of ground on the order of 0.227 m, the magnitude determined by the difference of mean sea-level in the two periods.—GDC

07007 **Grjebine, T.** Abundance of cosmic dust, *in* Mantles of the Earth and terrestrial planets (S. K. Runcorn, editor): London and New York, Interscience Publishers, p. 63-74, illus., table, 1967.

Cosmic dust is abundant, appearing as a major constituent of oceanic sedimentation. Measurements of accretion rates on Earth and comparison of results are difficult due to variable results caused by different sampling methods and absence of uniformly applicable cosmic criteria. Accretion rates have varied with time, but ignorance of the dust origin prohibits any conclusions on its role in the Earth's formation.—JPF

01653 **Grossman, I. G.** Origin of the sodium sulfate deposits of the northern Great Plains of Canada and the United States, *in* Geological Survey research 1968, Chap. B: U.S. Geol. Survey Prof. Paper 600-B, p. B104-B109, illus., 1968.

Widespread surficial deposits of sodium sulfate in the northern Great Plains may have been derived from deeply buried evaporites of the Devonian Prairie Formation. Ground water from the Rocky Mountain area presumably circulated eastward into the large structural basin underlying the Great Plains in Canada and northern United States, dissolving evaporites at great depth from late Devonian time onward. In late Pleistocene time, ascending mineralized ground water discharged into melt water channels in stratified drift overlying buried bedrock valleys. Freezing segregated pure crystals of sodium sulfate which accumulated in meromictic lakes. Residual brines discharged into streams draining southward into the Missouri River system. Rising temperatures and increasing aridity gradually disintegrated the drainage pattern in an area where deposits are preserved beneath extinct or shrunken lakes.—*from* Author's abstract

Guild, Philip W. *See* Wright, Wilna B. 01380

07022 **Guilday, John E.; Hamilton, Harold W.; Adam, Eleanor K.** Animal remains from Horned Owl Cave, Albany County, Wyoming: Wyoming Univ. Contr. Geology, v. 6, no. 2, p. 97-99, table, 1967.

Fragmentary remains of 25 species of mammals were found during the course of the 1966 excavations at Horned Owl Cave. Camel, *Camelops*, and a large species of horse, *Equus*, are extinct. Mountain goat, *Oreamnos*, no longer occurs in Wyoming. Pika, *Ochotona*, and spruce vole, *Phenacomys*, do not occur in the vicinity of the cave today. The remaining species are characteristic of the area today or in the recent past.—Authors' abstract

07087 **Guilday, John E.** The climatic significance of the Hosterman's Pit local fauna, Centre County, Pennsylvania: Am. Antiquity, v. 32, no. 2, p. 231-232, table, 1967.

Charcoal associated with mammal bones found beneath sealed sinkholes in Hosterman's Pit, a limestone cave, was radiocarbon dated at 7290 B.C.±1000. The Hosterman's Pit local fauna, here listed, represents the earliest known date for a "Recent" temperate fauna in northeastern North America; the New Paris No. 4 local fauna, from a cave 65 miles to the southwest, dated at 9300 B.C.±1000, represents a boreal fauna. Thus, within a probable time span of 2,000 years (or a maximum of 4,000 years), the mammalian fauna of central Pennsylvania changed from an assemblage of cold-weather species characteristic of central Canada today to the temperate fauna that still lives in the area.—VMJ

01575 **Güven, N.** The crystal structures of $2M_1$ phengite and $2M_1$ muscovite: Carnegie Inst. Washington Yearbook 66, 1966-67, p. 487-492, illus., tables, 1968.

Mica modifications are considered as different stacking sequences of topologically similar but not identical units. Precise analyses of the structure of these units may reveal factors controlling the stacking sequence. This study considers structural changes in single muscovite layers caused by isomorphic substitutions. Precise unit-cell dimensions were determined by least-squares refinement; interatomic distances and angles for both minerals were calculated by computer, and important bond lengths are tabulated. Distortions in the plane of basal oxygens are twice as great in Georgia muscovite as in phengite from Tiburon Peninsula, Calif.; and tetrahedra in the latter are 0.06±0.01 A less tilted, which probably causes c axis shortening in phengite. These results of Mg substitution may explain why phengite is more stable than muscovite in a high-pressure, low-temperature environment.—ESL

01576 **Güven, N.** A mechanism of stacking sequences in dioctahedral micas: Carnegie Inst. Washington Yearbook 66, 1966-67, p. 492-494, illus. p. 491, 1968.

The symmetry of the single layer, determined by defects, isomorphic substitutions, order-disorder, and distortions, generates the periodicity of the stacking sequence. The relations of top and bottom tetrahedral layers around the interlayer cation are the same for $2M_1$ and 3T muscovite. The role of interlayer cations, as proposed

here, is secondary in generating stacking sequences, in contrast to its primary importance in the hypothesis of Radoslovich (1960, 1963).—ESL

Güven, N. *See* Morimoto, N. 01577

06975 **Haarlöv, Niels.** Arthropoda (Acarina, Diptera) from subfossil layers in West Greenland: Medd. om Grönland, v. 184, no. 3, 17 p., illus., table, 1967.

Studies in bog geology were made during archaeological investigations in the former settlement of Sermermiut near Jacobshavn. This paper describes chitinous remnants of arthropods sorted out from peat samples from 13 layers in a swamp area which emerged in the middle of the second millenium B.C. Since then changes in the climate have caused changes in the plant communities; these are reflected in the different sediments of layers in the section as shown in plates at end of article. Brief descriptions of these plant communities are given, and each arthropod species is correlated quantitatively with the layer in which it was found. None were found in the bottom two layers which represent marine shore habitats.—GDC

07083 **Hadleigh-West, Frederick.** The Donnelly Ridge site and the definition of an early core and blade complex in central Alaska: Am. Antiquity, v. 32, no. 3, p. 360–382, illus., 1967.

Excavation at the site of Donnelly Ridge in central Alaska has led to delineation of an early core and blade culture, the Denali complex, which also includes the Campus site, near Fairbanks, and two sites previously excavated on the Teklanka River. These sites are linked by distinctive microblade cores that differ from those of three other distinct core and blade cultures in Alaska. The Denali complex seems to be related most closely to several late Upper Paleolithic sites in Siberia west of Lake Baikal, less closely to sites in Kamchatka and Hokkaido. Although no dependable radiocarbon dates are yet available for the Denali sites, dates from other sites suggest that the bearers of this culture probably entered Alaska in late Wisconsin time, 25,000 to 12,000 years ago, before final submergence of the Bering land bridge.—VMJ

Hadley, Jarvis B. *See* Miller, Ralph L. 01392

06961 **Haglund, Wayne M.** Brachiopod genus *Enteletes* in Pennsylvanian deposits of Kansas: Kansas Univ. Paleont. Contr.—Paper 23, 30 p., illus., tables, 1967.

Enteletes [Orthida, Enteletacea] in Kansas first occurs in upper Missourian finely crystalline limestones, in abundance along the periphery of biostromes with brachiopods, corals, and bryozoans. Diagnostic external characters of species are: distance from dorsal beak to origin of fold and lateral plications; size of fold angle; length–thickness ratio as expressed in reduced major axes, both in slope and intercept. Internal characters are a prominent median septum, crura-like brachiophores, trilobed cardinal process. Exopunctae and endopunctae are present in shell microstructure. Fine radial costellae ornament the surface. Species previously reported in Kansas are redescribed; *E. transversus, E. hemiplicatus, and E. pugnoides* are valid species. Three new species, *E. beilensis, E. churchensis, E. brownvillensis*, are moderately abundant in the Virgilian.—*from* Author's abstract

01445 **Halbouty, Michel T.** The supply and demand of geologists: GeoScience News, v. 1, no. 4, p. 12–14, 1968.

There is a looming shortage of petroleum geologists, which is symptomatic of the entire spectrum of Earth sciences. At the same time the petroleum industry has to find and produce more petroleum products in the next 20 years than has been done in the last 105. Information gathered from reports and studies shows that Earth science education and space programs are attracting an increasing number, but the inconsistency that has the most detrimental effect on students, is the fact that there are so many experienced geologists laid off, while there are so many opportunities for graduates. The AAPG has a newly created committee working with industry and universities for a better understanding.—ESL

01402 **Hall, Leo M.** Bedrock geology in the vicinity of White Plains, New York, Trip A *in* Guidebook to field excursions—New York State Geol. Assoc., 40th Ann. Mtg., Flushing, N. Y., 1968: Brockport, N. Y., State Univ. Coll., Dept. Geology, p. 7–31, illus., 1968.

Stratigraphic relations, including two unconformities, are well displayed by the bedrock in the White Plains quadrangle. Fifteen units in the "New York City Group" can be mapped. At the lower unconformity, Cambrian Lowerre Quartzite or Inwood Marble rest on Precambrian Fordham or Yonkers Gneiss. At the upper unconformity, the lower member of the Manhattan Schist rests on various units of the Inwood, Fordham, and Yonkers Formations. A major thrust fault may occur near or at the base of the traditional Manhattan Schist. There are four and possibly five deformation phases; each is described. A road log of 57 miles with eleven stops is included.—*from* Author's introduction

07034 **Hamblin, W. Kenneth.** Exposure charts for radiography of common rock types: Brigham Young Univ. Geology Studies, v. 14, p. 245–258, illus., tables, 1967.

X-ray radiography can be of significant value in the study of textures, structures, and fabric of rock specimens and unconsolidated sediments; but sample preparation, use of facilities available, and establishing correct exposure data may be costly in both time and materials. This paper outlines the basic techniques of radiography and presents exposure charts for making radiographs of the most common rock types.—Author's abstract

Hamid, Suliman. *See* Harton, James H. 07038

Hamilton, Harold W. *See* Guilday, John E. 07022

01517 **Hannell, F. G.** Research projects at Resolute: Arctic, v. 21, no. 1, p. 42–44, 1968.

Integrated studies in physical geography were made by a party from McMaster University in the summer of 1967, within a 100 sq-mi area near Resolute Air Base on Cornwallis Island, Northwest Territories. Long profiles across raised shorelines were complemented by shorter profiles across modern beaches, which posed separate and interesting problems concerning the relationship between process and form in a coastal environment of severely limited open water. At the end of the study period, narrow stretches of tidal water appeared in some inshore areas, which led to a modified form of certain beaches. In pedological investigations of an 80-sq mi area, surface materials were mapped, classified in 8 categories, further subdivided by size analysis and sorting, and clay properties, in pursuit of the degree of chemical weathering.—GDC

01586 **Hansen, Edward.** Natural slip folds in which the fold axes nearly parallel the slip lines: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 536–538, illus., 1968.

It has been assumed that fold axes are oriented perpendicular to the direction of sliding between beds or slip across beds that resulted in folds. The validity of this assumption is questionable when it is applied to folds in metamorphic rocks where the mechanism is likely to be quite different. Mean slip-line orientations have been deduced by several methods for three areas of late slip folds in the metamorphic rocks of Trollheimen, Norway. Histograms show that the angles between the mean slip-line orientations and fold axes spread from 0° to 40°, with the mode in the 5° to 10° class interval. Fold axes and slip lines of folds that may have been produced by slip should be determined independently. Kinematics of accepted models of alpine-type mountain building are examined in the light of this information.—ESL

01587 **Hansen, Edward; Scott, William H.** Real versus apparent displacement in slip folds: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 538–539, illus., 1968.

The amplitude of a fold in profile has been considered a good approximation of the distance that bedding has been displaced to form it. A better measure of bedding

displacement during slip folding is defined by the ratio of displacement parallel with the slip lines over the amplitude, or the cosecant of the angle between slip lines and fold axis. When this is applied to the slip folds in Trollheimen, Norway, it is found that the displacement is an order of magnitude greater than apparent in the profile sections.—ESL

07052 **Hanshaw, Bruce B.; Back, William; Rubin, Meyer.** Carbonate equilibria and radiocarbon distribution related to groundwater flow in the Floridan limestone aquifer, U.S.A. [with French abs.], *in* Hydrology of fractured rocks—Dubrovnik Symposium, 1965, Proc., V. 2: Internat. Assoc. Sci. Hydrology Pub. 74, p. 601–614, illus., tables, 1967.

The principal artesian aquifer of Florida is composed predominantly of Tertiary limestone with lesser amounts of dolomite and gypsum. A N–S geohydrologic section through the piezometric high depicts spatial and temporal changes of chemical character of water. Major area of recharge is characterized by calcium bicarbonate type water, low concentration of total dissolved solids and of sulfate ions, undersaturation with respect to calcite and dolomite, and young C–14 ages. Away from the recharge area the water is supersaturated with respect to calcite and dolomite. Throughout most of the area the water has not reached equilibrium with aragonite and gypsum. Supersaturation of the water with respect to calcite tends to buffer the bicarbonate concentration. This study shows that the geochemistry of the water conforms well with the hydrologic history of the system.—*from* Authors' abstract

01584 **Hare, P. E.; Abelson, P. H.** Racemization of amino acids in fossil shells: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 526–528, tables, 1968.

Since changes in amino acids with time are of interest in origin and evolution of life, the present study determines their optical configuration in Recent and fossil *Mercenaria* shells. The total amount of acids present decreases with age, and the distribution changes. Complete racemization has occurred in the Miocene specimen, and appreciable amounts in the upper Pleistocene. Results indicate that for most amino acids the mixture of stereo forms accumulating in a primitive ocean would be racemic. Racemization would vitiate any slight advantage to one form or another, but once a decision was made to use the *L* form (common to proteins of all living forms), supplies would be replenished.—ESL

07072 **Harland, W. B.** (and others, editors). The fossil record—A symposium with documentation: London, Geol. Soc. London, 827 p., illus., 1967.

The symposium papers in Part 1 cover areas exclusive of North America and are not cited. Part 2, documentation of the fossil record (30 chapters) includes seven papers cited individually. The stratigraphically earliest and latest occurrences of taxa are documented and related as precisely as possible to a standard scheme of stratigraphic divisions devised for this volume. It was believed that information on known ranges was needed as opposed to the hypothetical ones often ascribed.—ESL

01214 **Harper, John D.** Character, origin, and significance of Late Silurian barrier island—Fuyk Sandstone Member of Rondout Formation, Hudson Valley, eastern New York State [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 530, 1968.

07107 **Harris, P. G.** Segregation processes in the upper mantle, *in* Mantles of the Earth and terrestrial planets (S. K. Runcorn, editor): London and New York, Interscience Publishers, p. 305–317, illus., tables, 1967.

The best evidence for the composition of the mantle comes from ultrabasic rocks and ultrabasic xenoliths in volcanic rocks. Other data about the upper mantle is provided by experimental studies on stability relations at high pressures. Melting in the upper mantle is partial rather than complete and depends on ways in which heat can be localized. High-pressure studies indicate that the first-formed liquid becomes increasingly deficient in silica with increasing pressure. Concentration processes likely to operate between liquid and solid phases are outlined. The content

of residual trace elements reflects the concentration history of the liquid. Crustal segregation processes that operate on Earth are likely to produce different end products in planets of different size and temperature.—JPF

07144 **Harris, P. G.; Reay, A.; White, I. G.** Chemical composition of the Upper Mantle: Jour. Geophys. Research, v. 72, no. 24, p. 6359–6369, illus., tables, 1967.

Extraterrestrial data are not likely to provide quantitative values for the chemical composition of the upper mantle. Three groups of terrestrial materials, ultramafic rocks, olivine nodules from basalts, and garnet peridotite nodules from kimberlites, probably are directly derived from the upper mantle. Each group has a wide range of composition. However, the estimates for the composition of original or undepleted mantle derived independently from each source approach a common value. When this composition is recalculated as probable mineral assemblages, the pyroxene peridotite and garnet peridotite zones both contain about 65 percent of olivine. The range of composition of each group is consistent with compositional heterogeneity in the upper mantle.—Authors' abstract

Hart, S. R. *See* Krogh, T. E. 01585

07038 **Harton, James H.; Hamid, Suliman; Abi-Chedid, Eddy; Chilingar, George V.** Effects of electrochemical treatment on selected properties of a clayey silt: Eng. Geology—Internat. Jour., v. 2, no. 3, p. 191–196, illus., 1967.

Experimental results show that electrochemical treatment using iron pipes for both the anode and the cathode can have a pronounced stabilizing effect on clayey silt. Soils were strengthened as a result of application of direct electrical current together with the introduction of calcium chloride, followed by aluminum sulfate. Increases in cohesion of the order of 150–500 lb/sq ft are possible. The beneficial effects were not reduced by subsequent water encroachment. Formation of new minerals in former voids and resulting cementation of the treated soil appears to be the main factor causing increased soil density and cohesion.—*from* Authors' summary

Hartwell, John W. *See* Hosterman, John W. 01393

01469 **Hatfield, Craig B.; Rohrbacher, Timothy J.; Floyd, Jack C.** Directional properties, paleoslope, and source of the Sylvania Sandstone (Middle Devonian) of southeastern Michigan and northwestern Ohio: Jour. Sed. Petrology, v. 38, no. 1, p. 224–228, illus., 1968.

Dip orientations of 202 crossbedded units at 7 localities in Sylvania Sandstone yielded modal directions toward the north and west. Grain orientations obtained from 25 thin sections agree with the crossbed orientations. Both coincide with the directions of regional paleoslope and decreasing stratigraphic hiatus. Marine fossils and other evidence suggest a marine depositional environment. The presence at some locations of strong secondary modal crossbed orientations at 180 degrees from the primary mode suggests marine transgression in a beach environment.—RAC

01464 **Hattin, Donald E.** Volumetric histogram for field study of carbonate sediments: Jour. Sed. Petrology, v. 38, no. 1, p. 262–264, illus., table, 1968.

The volumetric histogram is a teaching aid which permits field evaluation of sediment size distribution. Wet sediment fractions are taken from a standard sieve series and placed in graduated cylinders that are mounted in a row on a wooden base assembly. The resulting histogram can be used at the sample station for visual estimation of statistical parameters.—Author's abstract

Head, James W., 3d. *See* Mutch, Thomas A. 01463

Heald, Emerson F. *See* Speidel, David H. 06999

01511 **Heath, Ralph C.; Trainer, Frank W.** Introduction to ground-water hydrology: New York and London, John Wiley and Sons, 284 p., illus., tables, 1968.

The subject matter of this textbook is divided into five parts, each with several chapters: hydraulic characteristics of rock (unit elements), hydraulic characteristics of aquifers (reservoir and pipeline functions, flow nets, aquifer boundaries), field determination of transmissibility and storage coefficients, effect of environment on ground water (chemical content and temperature), and ground-water syntheses—maps, and budget studies. Suggestions for laboratory and field projects, references, constants and equivalents are in five appendices.—ESL

01345 **Hedberg, William Hollis.** Pore-water chlorinities of subsurface shales [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 8, p. 3338B-3339B, 1968.

01215 **Heezen, Bruce C.** Contour currents and turbidity currents [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 530, 1968.

07050 **Heindl, L. A.** Ground water in fractured volcanic rocks in southern Arizona [with French abs.], *in* Hydrology of fractured rocks—Dubrovnik Symposium, 1965, Proc., V. 2: Internat. Assoc. Sci. Hydrology Pub. 74, p. 503-513, illus., 1967.

The water-bearing potential of fractured volcanic rocks in southern Arizona is virtually untested, largely because adequate amounts are obtained from alluvial deposits. Wells in the flows yield up to 1,000 gpm, but these are variable and cannot now be predicted. Fractured volcanics in the basin-and-range area also underlie areas of recharge in the mountains and act as conduits to transmit water to ground-water reservoirs in alluvium of basin fill or in permeable volcanic rocks buried by or interbedded with alluvium. Criteria are needed to identify, map, and project fractures to below the surface. Principal means for meeting these needs are determination of relationship of permeability to mode and environment of extrusion and deposition, and to subsequent deformation and erosion.—*from* Author's abstract

01605 **Helmstaedt, Herwart.** Note on plant fossils from Beaver Harbour, N. B.: Maritime Sediments, v. 3, no. 4, p. 119, 1967 [1968].

A fossil plant assemblage recently described as Upper Devonian (Helmstaedt, ibid., v. 2, no. 4, 1966), should be considered at least Upper Devonian, as suggested by structural evidence, and possibly even younger. Written communication from J. A. Schopf, who reexamined the material with S. H. Mamay from the U.S. Geological Survey, suggests possible reidentification, suggesting that the Beaver Harbour beds are of Lower Carboniferous age, which would bridge the gap between the Perry Formation and the Upper Carboniferous plant beds at Saint John. A final account of the author's work is still not ready for publication, but it can be concluded that these strata are higher than the red beds at Blacks Harbour, which are considered equivalent of the Perry Formation.—GDC

01216 **Hemphill, Charles R.; Smith, R. I.; Szabo, F.** Geometry of Devonian Swan Hills reef complex—Alberta, Canada [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 530-531, 1968.

01630 **Henderson, G. V.** Pyrophyllite-bearing clay in Clinton deposit, Utah County, Utah: Utah Geol. and Mineralog. Survey Spec. Studies 23, 28 p., illus., tables, geol. map, 1968.

With an estimated production of 3/4 million tons, the Clinton deposit west of Lehi has been and continues to be a major source of clay for low duty refractories and structural clay products in the intermountain area. It is obtained from the weathered upper parts of steeply dipping shale beds in the Manning Canyon Shale of Mississippian and Pennsylvanian age; associated quartzite and limestone beds provide protection from rapid erosion. The refractory properties of the clay are due to pyrophyllite and enhanced by an unusual proportion of associated kaolin. The pyrophyllite probably was emplaced by hydrothermal solutions subsequent to diagenesis, during or immediately subsequent to deformation. Weathering of the shale has removed deleterious carbonates and carbonaceous material, thereby enriching the content of refractory material.—*from* Author's abstract

01367 **Herz, Norman; Eilertsen, Nils A.** Titanium, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 437–443, illus., tables, 1968.

Titanium, from ilmenite, rutile, and other minerals occurs in North Carolina in weathered igneous rocks and as placers, although none is currently being worked.—HRC

Hester, Norman C. *See* Pryor, Wayne A. 01188

01509 **Hewitt, William Paxton.** Geology and mineralization of the main mineral zone of the Santa Eulalia district, Chihuahua, Mexico: Soc. Mining Engineers Trans., v. 241, no. 2, p. 228–260, illus., 1968.

The main mineral zone occurs in a gently warped dome with simple associated structures and contains orebodies distributed through a vertical range of over 900 m. Middle Cretaceous limestones form the bulk of the Cerro de Santa Eulalia and are unconformably overlain by Tertiary tuffs and flows intercalated with continental sediments. Abrupt shrinkage in the volume of limestones associated with large replacement orebodies occurred during mineralization. Contacts of limestone with igneous sills and fossiliferous limestone beds have been important localizers of orebodies. Thrust zones displacing diabase sills are intruded by rhyolite porphyry sills, to which mineralizers are related. Fields of unreleased strain may have influenced orebody locations, the zoning pattern may be a reflection of the filtering effects of large volumes of limestone, and metal-rich brines mobilized or incorporated in the porphyry might be the source of mineralizers.—ESL

Heyl, Allen V. *See* Wedow, Helmuth, Jr. 01331

Heyman, Louis. *See* Lytle, William S. 07014

High, Lee R., Jr. *See* Picard, M. Dane. 01184

01217 **High, Lee R., Jr.** Storms and sedimentary processes along northern British Honduras coast [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 531, 1968.

01333 **High, Lee R., Jr.; Picard, M. Dane.** Dendritic surge marks ("*Dendrophycus*") along modern stream banks: Wyoming Univ. Contr. Geology, v. 7, no. 1, p. 1–6, illus., 1968.

Dendrophycus, originally described as the imprint of a marine alga of uncertain affinities, has long been suspect and is now generally considered to be a rill-mark. Several structures identical to *Dendrophycus* have been seen along creek banks in Wyoming and Colorado. These structures were observed to form as flood waters surged against the bank and eroded a modified dendritic pattern. The requirements for formation are: steep slope, semi-consolidated silt or fine sand, standing water, and surging currents. These conditions occur in marine and paralic settings, as well as fluvial. Because the structure is inorganic, the term dendritic surge marks is suggested.—*from* Authors' abstract

01346 **Hill, John Gilmore.** Sandstone petrology and stratigraphy of the Stanley Group (Mississippian), southern Ouachita Mountains, Oklahoma [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 8, p. 3339B, 1968.

Hite, Robert. *See* Peterson, James A. 01183

01218 **Ho, Clara; Coleman, James M.** Diagenetic changes of organic sediments in Atchafalaya basin, Louisiana [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 531–532, 1968.

Ho, Clara. *See* Gagliano, Sherwood M. 01225

Hobbs, Robert G. *See* Wedow, Helmuth, Jr. 01374

Hobbs, Robert G. *See* Thayer, T. P. 01376

Hobbs, Robert G. *See* Kinkel, Arthur R., Jr. 01378

Hobbs, Robert G. *See* Parker, Raymond L. 01382

Hobbs, Robert G. *Se* Brobst, Donald A. 01390

Hodson, F. *See* Donovan, D. T. 07056

Hoering, T. C. *See* Mitterer, R. M. 01582

01583 **Hoering, T. C.** Organic acids from the oxidation of Recent sediments: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 515–526, illus., tables, 1968.

A small percentage of the organic matter in a Recent sediment is soluble in organic solvents, but the bulk is a dark polymer of unknown structure. Oxidative degradation permits an estimation of the amounts and chain lengths of normal alkyl groups in the polymer. The necessary procedures have been developed and applied to a set of Recent marine sediments taken from basins in the continental shelf off southern California. The acids already present were separated first, then the remaining organic matter was treated with an oxidizing agent and new acids generated. First the aliphatic acids with two to nine carbon atoms were isolated, and second the mono- and dicarboxylic acids, up to 28 carbon atoms. Flow sheets for the procedures are given.—ESL

07047 **Hollingsworth, J. S.** Geology of the Wilson Springs vanadium deposits, *in* Central Arkansas economic geology and petrology—Geol. Soc. America, Field Conf. 1967, Guidebook: Little Rock, Ark., Arkansas Geol. Comm., p. 22–24, illus., table, 1967.

Near Wilson Springs, Garland County, are the only deposits specifically mined for vanadium in the United States; they are marginal to the small Potash Sulfur Springs intrusive. This Late Cretaceous alkalic igneous complex has a crude ring structure similar to the Magnet Cove intrusive. The outer ring of alkalic syenite and fenite forms a ridge; the central nepheline syenite has a core of calcite-cemented breccia. Carbonatite occurs in dikes and irregular masses near the margin. Saprolite averaging 40 feet thick covers much of the area, except the syenite ridge. Mineral constituents of the various rocks are listed; many dikes are xenolithic. The sedimentary rocks, folded and faulted in the Late Pennsylvanian Ouachita orogeny, are metamorphosed close to the intrusive; vanadium ores occur near the contact. The stratigraphic units, Ordovician to Mississippian, are tabulated with brief description and thicknesses.—GDC

Hooijer, D. A. *See* Butler, P. M. 07055

01219 **Hoskin, Charles M.** Progress report on two unusual Alaskan sediments—Recent beach carbonate from Three Entrance Bay, and polished grains from Easter Egg Hill [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 532, 1968.

07133 **Hoskins, Donald M.** Origin of locally overturned strata in northern Dauphin County, Pennsylvania: Pennsylvania Acad. Sci. Proc., v. 40, no. 2, p. 99–103, illus., 1967.

Overturned, north-dipping and faulted strata of the Mississippian Pocono Formation are exposed on the east side of the Susquehanna River water gap through Mahantango Mountain two miles north of Millersburg, Pa. The overturned strata and faults interrupt the normal south dip of the bedding and are the result of local reverse faulting which apparently occurred near the end of the formation of the major structures of the area. Movement from north to south on the local faults dragged the strata into their present overturned position. The net effect of the faulting was to permit additional shortening of the rock column initiated during folding with resultant extension of the vertical direction.—Author's abstract

07110 **Hospers, J.** Review of palaeomagnetic evidence for the displacement of continents, with particular reference to North America and Europe–northern Asia, *in* Mantles of the Earth and terrestrial planets (S. K. Runcorn, editor): London and New York, Interscience Publishers, p. 331–349, illus., tables, 1967.

Sources of possible systematic errors in paleomagnetic inclinations of sediments can be corrected by a system of paleomagnetic triangulation. Igneous rocks appear to yield small discrepancies, but large errors in inclination are found among Paleozoic sedimentary rocks in North America. New data allow a polar wandering curve to be proposed that may be common to both North America and Europe–northern Asia. The data presented are thought to contradict continental drift, at least since Cambrian time.—JPF

01393 **Hosterman, John W.; Patterson, Sam H.; Sweeney, John W.; Hartwell, John W.** Clay, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 167–188, illus., tables, 1968.

A cursory review of the origin, occurrence, and uses of clay in Appalachia is given; most of the data are tabulated. Fire clay, shale, and kaolin are the chief products discussed.—HRC

House, M. R. *See* Donovan, D. T. 07056

01680 **Hovis, W. A., Jr.; Blaine, L. R.; Callahan, William R.** Infrared aircraft spectra over desert terrain 8.5μ to 16μ: Appl. Optics, v. 7, no. 6, p. 1137–1140, illus., 1968.

Spectra taken at various altitudes over relatively uniform desert terrains [Mojave Desert, Calif.] show attenuation of upwelling radiation by atmospheric gases and haze through the entire spectral interval. Equivalent blackbody temperatures, even in the clearest part of the window, show a drop that could introduce serious errors into remote sensing of surface temperatures. Surface emissivity characteristics are discernible at low altitudes but are somewhat masked by ozone at 10-km altitudes.—*from* Authors' abstract

01416 **Howard, Arthur D.** Joseph John Graham (1909–1967): Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 503–504, portrait, 1968.

Howarth, M. K. *See* Donovan, D. T. 07056

01220 **Hrabar, Stephanie V.; Potter, Paul Edwin.** Sedimentologic and reservoir characteristics of abandoned delta distributary [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 532, 1968.

01537 **Huckenholz, H. G.; Schairer, J. F.; Yoder, H. S., Jr.** Synthesis and stability of ferri-diopside: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 335–347, illus., tables, 1968.

To study the nature of the incorporation of ferric iron in the diopside in the absence of soda, a series of compositions in the plane diopside–wollastonite–hematite of the quaternary system CaO–MgO–Fe_2O_3–SiO_2 was prepared along the joins diopside–ferri-Tschermak's molecule, diopside–andradite, and diopside–hematite, as well as some additional points in this plane. The maximum solid solution of the ferri-Tschermak's molecule in diopside is 33 percent by weight at 1157°C, and that of hematite in diopside is 6 percent at 1292°C. Results indicate the formation of ferri-diopside solid solutions at magmatic temperatures.—MST

01221 **Hudnall, James S.; Eaton, R. W.** Geology of Woodbine Formation in East Texas oil field and related areas [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 532–533, 1968.

01222 **Huff, Warren D.; Breuer, Joseph W.** Mineralogy and distribution of clay sediments in Great Miami River basin (Ohio–Indiana) [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 533, 1968.

Hughes, N. F. *See* Banks, H. P. 07070

01223 **Huh, Oscar K.** Mississippian carbonate sedimentation across miogeosyncline-craton hinge zone, east-central Idaho-southwestern Montana [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 533-534, 1968.

Humphreys, C. P., Jr. *See* Newcome, Roy, Jr. 01491

Hunn, J. D. *See* Rosenshein, J. S. 01528

Hunn, J. D. *See* Rosenshein, J. S. 01608

01465 **Hunter, Ralph E.; Lamar, J. E.** A new method for making pebble counts: Jour. Sed. Petrology, v. 38, no. 1, p. 264-265, illus., 1968.

Pebble composition, classification, and counting studies are simplified if the pebbles are cemented together in a block and the block is then cut into slices with a rock saw.—RAC

Hussell, D. J. T. *See* Barr, W. 01516

01504 **Hutt, Jeremy R.; Berg, Joseph W., Jr.** Thermal and electrical conductivities of sandstone rocks and ocean sediments: Geophysics, v. 33, no. 3, p. 489-500, illus., tables, 1968.

Relationships between electrical and thermal conductivities of consolidated sandstone rocks and sediments were investigated. Equations are given which relate the two conductivities for the rocks, and thermal and electrical conductivities for sediments. Data from 65 rock samples and 105 sediment samples were used in establishing the reliability and parameter values of the equations. The derived equations can be used to determine thermal conductivities from electrical conductivities providing thermal conductivities of the solid constituents can be approximated. For samples of sandstone, deviations of data from values predicted by equations are shown to be related to variations in composition of the samples. Within the accuracy of the data, the thermal conductivities of sediment samples seem to be controlled more by the water content than by the mineral composition.—*frm* Authors' abstract

01361 **Ibrahim, Abou-Bakr Khalil.** Travel-time curves and upper mantle structure from long period S-waves [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 8, p. 3348B, 1968.

01213 **Imbrie, John.** Alternate models of community variation [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 534, 1968.

07015 **Ionin, A. S.** Rel'yef beregovoy zony o. Kuba [with English summ.]: Akad. Nauk SSSR Okeanologiya, v. 7, no. 2, p. 287-301, illus., 1967; English translation, Acad. Sci. USSR Oceanology, v. 7, no. 2, p. 222-234, illus., 1967.

Preliminary results of the Soviet-Cuban Expedition of 1965, whose objective was the study of bottom relief and sediments in the littoral zone of Cuba, have shown that, in the past, coastal development involved the action of waves under conditions of an abundant supply of biogenic and chemogenic material. Islands and barrier reefs protect extensive areas from the action of waves of the open sea. Biogenic factors play an important role in present-day coastal development, particularly mangrove vegetation. The shores of the open coastal areas are destroyed by the combined action of wave and chemical abrasion.—GSA Bib Staff

01438 **Isaacs, John D.; Brown, Daniel M.** "Bootstrap" corer: Jour. Sed. Petrology, v. 38, no. 1, p. 159-162, illus., 1968.

A new coring tool, capable of penetrating ocean sediments to a depth of at least 5 to 7 meters and termed a "bootstrap" corer, features: (1) light weight (approx. 140 kg for a tube 7 m long), (2) simplicity, (3) large internal diameter (approx. 13 cm), (4) powerful "vacuum" operation, (5) deep penetration, (6) a novel piston

and pullout relief mechanism that minimizes pullout forces, and (7) a not abnormal distortion of the sediment sample.—*from* Authors' abstract

Jagodits, Frank L. *See* Swift, Donald J. P. 01417

Jarosewich, E. *See* Mason, Brian. 01507

07058 **Jefferies, R. P. S.; Joysey, K. A.; Paul, C. R. C.; Ramsbottom, W. H. C.** Echinodermata—Pelmatozoa, Chap. 21 *in* The fossil record—A symposium with documentation: London, Geol. Soc. London, p. 565–581, illus., 1967.

The range of 37 families, 3 subfamilies, 17 suborders, and 7 orders in 6 classes, and of 5 classes of Pelmatozoa are documented, and 2 range charts are included.—ESL

Jensen, Bartell C. *See* Clyde, Calvin G. 07016

07045 **Jensen, Ronald G.** Ordovician brachiopods from the Pogonip Group of Millard County, western Utah: Brigham Young Univ. Geology Studies, v. 14, p. 67–100, illus., 1967.

Twenty-five species of Brachiopoda from a very complete section, largely from the southern Confusion Range, are described and zoned; three of the species are new. The House Limestone at the base of the section has two zones; small inarticulate brachiopods occur throughout. The overlying Fillmore, Wahwah, and Juab formations are characterized by different zones. The Kanosh Formation, largely shale, also has a distinctive fauna, as does the next overlying Lehman Limestone. The topmost Crystal Peak Dolomite contains silicified brachiopods. The zones in Utah differ somewhat from those of the Whiterock Stage in central Nevada.—*from* Author's abstract

06979 **Jiménez, Antonio Nunez.** Poznámky o krasu na Kube [with Spanish summ.]: Carolinae Univ. Acta—Geographica 2, p. 27–48, illus., 1967.

The extensive karst topography of Cuba, presenting a varied morphology of real importance, results from the presence of great quantities of Jurassic to Quaternary limestones in an intertropical zone with dry and wet seasons. The following seven forms of karst topography can be distinguished: conical (mogotes); karst of the hills, mountains, and plateaus; flatland karst; partially submerged in swampy zones; partially submerged in the sea; coastal karst; and on emerged lands.—ESL

01168 **Jodry, R. L.** Growth and dolomitization of Silurian reefs, St. Clair County, Michigan [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 534, 1968.

01662 **Johnston, F. J.** Abram Lake area (east part), District of Kenora: Ontario Dept. Mines Prelim. Geol. Map P. 469, scale 1 in. to 1/4 mi., text, 1968.

Abram Lake area consists essentially of part of two main volcanic belts both bordered on the south by a belt of metasediments and separated by a major fault. The Little Vermilion fault trends NE through Abram Lake and separates the metavolcanics south of the lake from the later metasediments; parallel faults occur also. Faulting within East and Southeast Bays has segmented metasediments into a number of well-defined blocks. Prospecting for gold has occurred sporadically since the late 1800's, but no significant discoveries have been made; prospecting should be done in vicinity of known faults or shear zones where carbonization and alteration are evident. A pyrite zone is estimated to be 20–35 feet wide and reasonable continuity along strike is indicated. A brecciated and hybrid intrusive zone contains some disseminated sulfides and threads of pyrite, pyrrhotite, and chalcopyrite.—MCM

Jones, Blair F. *See* Clayton, Robert N. 01524

01480 **Jones, Thomas A.** Statistical analysis of orientation data: Jour. Sed. Petrology, v. 38, no. 1, p. 61–67, illus., 1968.

Directional data, if bimodal, concentrated over a small range, or determined only over a range of 180° are best treated by methods of statistical analysis different from those generally used. Before application of a statistical technique to directional data, the analyst should define the distribution of his population.—HEC

Joysey, K. A. *See* Jefferies, R. P. S. 07058

Kachadoorian, Reuben. *See* Sainsbury, C. L. 01421

01169 **Kahle, Charles F.** Petrology and structure of a Salina (Silurian) dolomitized algal stromatolite complex, northwestern Ohio [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 534–535, 1968.

01529 **Kaiser, W.; Zähringer, J.** K:Ar age determinations of iron meteorites—[Pt.] 4, New results with refined experimental procedures: Earth and Planetary Sci. Letters, v. 4, no. 1, p. 84–88, 1968.

The neutron activation techniques for K and Ar–40 determinations in iron meteorites have been improved. The high Ar–40:K ratios are most likely caused by K losses. Schreibersite loses K just by leaching with water. In samples containing troilite a Kr–83 activity of the same half life as Ar–41 is built up from Se. Therefore, Ar and Kr need to be separated with gas–chromatography techniques. K:Ar ages of three iron meteorites with high K contents measured by the improved techniques lie around 4.8×10^9 years. Many other iron meteorites still give large Ar:K ratios which are most likely due to K losses by weathering. Further studies are needed.—Authors' abstract

Kanasewich, E. R. *See* Clowes, R. M. 01609

01597 **Kane, Julian.** Foraminifera: Sea Frontiers, v. 14, no. 3, p. 176–186, illus., 1968.

Foraminiferal shells on deep–sea bottom areas cover more of our planet than any other material, but very few shells are found on surfaces below a depth of 18,000 feet; they live also in shallow seas. More than 50,000 species have been recognized, mostly fossil forms. Hyaline and calcareous wall structures, and shell shapes are described and illustrated. Distribution of planktonic Foraminifera from submarine cores indicates temperature changes in the surface sea water, due to climate. During the Pleistocene, such changes affected the advance and retreat of continental glaciers. Analysis of oxygen isotopes in the shells also indicates the temperature at which they lived. These methods show that present–day temperatures are slightly cooler than those several thousand years ago. Foraminifera are also used by petroleum geologists to identify the formations being drilled.—ESL

Kaplan, I. R. *See* Brooks, R. R. 01594

01488 **Kaufman, M. I.; Dion, N. P.** Ground–water resources data of Charlotte, De Soto, and Hardee Counties, Florida: Florida Div. Geology Inf. Circ. 53, 24 p., illus., tables, 1968.

The ground–water data in this report constitute the basis for Florida Geol. Survey Map Ser. 27, Kaufman and Dion, 1967. Additional selected data, including records of wells and chemical analyses, on the ground–water resources of the three county area are included also.—MCM

Keller, George H. *See* Richards, Adrian F. 01190

01170 **Keller, W. D.** Clay minerals as cumulative records of their environments [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 535, 1968.

06973 **Kelley, Dana R.** Geology of the Red Valley sandstone in Forest and Venango Counties, Pennsylvania: Pennsylvania Geol. Survey, 4th ser., Bull. M 57 (Mineral Resources Rept.), 49 p., illus., tables, 1967.

The report is part of a study to establish geological frameworks for productive intervals in oil reservoirs by which exploration and development can be improved.

Facies are delineated within the widespread Red Valley, using scattered wells. Narrow nearshore belts of clean, porous sandstone, of greatest economic importance, become more laminated and cemented shelfward, forming trends of marginal importance. Farthest shelfward the zone breaks up into interbedded sandstones, siltstones, and shales, which grade into basin-type gray siltstones and shales. The facies indicate predictable Upper Devonian transgressive and regressive fluctuations. The amount and type of fines and secondary silica, carbonate, and clay cement, varies laterally in relation to facies, and vertically in the pay zone. A cross section, and an isopach map of shale-clean sandstone accompany the report.—ESL

Kermack, K. A. *See* Butler, P. M. 07055

07005 **Kerridge, J. F.** The mineralogy and genesis of the carbonaceous meteorites, *in* Mantles of the Earth and terrestrial planets (S. K. Runcorn, editor): London and New York, Interscience Publishers, p. 35–47, illus., 1967.

High-temperature chondrules and part of the low-temperature matrix of unmetamorphosed carbonaceous meteorites were formed quite early in the history of the solar system. It is not possible to derive one phase from the other; at least two separate evolutionary paths are required. Disequilibrium structures in carbonaceous meteorites and equilibrium of ordinary chondrites are explained by a postulated sequence of events in the evolutionary path of meteoritic material from a primitive solar nebula.—JPF

07121 **Kesling, Robert V.** Cystoids, *in* Treatise on invertebrate paleontology—Pt. S, Echinodermata 1, V. 1: New York, Geol. Soc. America (and Univ. Kansas Press), p. S85–S267, illus., tables, 1967.

Taxonomy of the crinozoan class Cystoidea von Buch, 1846, has attained its present state by removal of edrioasteroids, "carpoids", paracrinoids, edrioblastoids, and blastoids. Cystoids have a continuous theca of numerous plates with distinctive thecal pores, brachioles, a distinctive ambulacral system, and a short, possibly prehensile column. They are recorded from Lower Ordovician through Devonian. Though not abundant or widespread, they are notably diverse in form, with clear-cut taxonomic differences; 87 genera are placed in 22 families, seven superfamilies, and two orders (Rhombifera, with thecal pores arranged in pore rhombs extending equally over two adjoining plates; Diploporita, with pores in groups of two, confined to single plates). Morphology, ontogeny, paleoecology, distribution, and study techniques are discussed.—VMJ

07122 **Kesling, Robert V.** Paracrinoids, *in* Treatise on invertebrate paleontology—Pt. S, Echinodermata 1, V. 1: New York, Geol. Soc. America (and Univ. Kansas Press), p. S268–S288, illus., tables, 1967.

Paracrinoidea Regnéll, 1945, is a small class of crinozoans recorded only in Middle Ordovician rocks; though locally abundant, paracrinoids are confined mainly to North America. They have a continuous theca as in that of cystoids, pinnuliferous arms as in crinoids (but never more than four), and a flexible column as in blastoids. But they are distinguished from cystoids and eocrinoids by their uniserial ambulacral structures, from crinoids by the undifferentiated theca, from blastoids by irregularity of plate arrangement, complete lack of pentameral symmetry, and by form of the pore system. Of ten known genera, eight are placed in three families and two orders, Varicata and Brachiata. Taxonomy is presently based on form and attachment of the arms; the pore system, still largely unstudied, should provide a more significant grouping.—VMJ

Kimbrough, Charlotte. *See* Lanning, F. C. 07069

Kimmel, Grant E. *See* Walters, Kenneth L. 01624

01473 **King, Cuchlaine A. M.; Buckley, Jane T.** The analysis of stone size and shape in arctic environments: Jour. Sed. Petrology, v. 38, no. 1, p. 200–214, illus., tables, 1968.

Flatness and sphericity of stones depend on rock type whereas roundness is a function of the transporting and depositional process. Roundness is greatest in beach deposits and decreases through a series of deposits ranging from kames to lag deposits and moraines. Mean size increases in the same series. The relations between the two parameters permit identification of types of deposits.—HAT

King, Roger H. *See* Barr, W. 01516

01378 **Kinkel, Arthur R., Jr.; Feitler, Stanley A.; Hobbs, Robert G.** Copper and sulfur, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 377–385, illus., tables, 1968.

Most of the copper and associated sulfides, the source of sulfur in Appalachia, comes from Ducktown, Tennessee, and from North Carolina. The deposits are described cursorily. Other sulfide bodies are discussed also.—HRC

01171 **Kinsman, D. J. J.** Modes of formation, sedimentary associations, and diagnostic features of shallow-water and supratidal evaporites [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 536, 1968.

01476 **Kirtley, David W.; Tanner, William F.** Sabellariid worms—Builders of a major reef type: Jour. Sed. Petrology, v. 38, no. 1, p. 73–78, illus., 1968.

Sabellariid worms build extensive reefs along tropical and subtropical beaches. Detailed study of a system of reefs built by *Phragmatopoma lapidosa* along the lower East Florida coast demonstrates the ability of the worms to thrive in the breaker zone and to extend their colonial tube upward and seaward by agglutination of littoral sediment. Beachrock converted from the reefs and impoundment of sediment on their landward side provide for progradation of the beach. These organisms may have been instrumental in the construction and preservation of beaches in the geologic past.—HEC

01641 **Klausing, Robert L.** Geology and ground water resources of Cass County, North Dakota—Pt. 1, Geology: North Dakota Geol. Survey Bull. 47, pt. 1 (North Dakota Water Conserv. Comm. County Ground Water Study 8), 39 p., illus., tables, geol. map, 1968.

Cass County, 1,749 sq mi in southeastern North Dakota, is mainly in the Lake Agassiz basin; about one-fourth is in the Drift Prairie. Major stratigraphic units are Precambrian crystalline rocks, Ordovician Winnipeg Formation, and Cretaceous Dakota Sandstone, Graneros Shale and Greenhorn Formation. Known thickness of Pleistocene drift which covers the county ranges from 132–447 feet; all surficial features are late Pleistocene. Major surficial features are ice-marginal drainage channels and the channel of the proglacial Maple River; minor features include kames, eskers, terraces, and ground and local washboard moraines. The flatness of the Red River Valley is interrupted by the escarpment of the Sheyenne delta and beaches of glacial Lake Agassiz.—*from* Author's abstract

01172 **Klingspor, A. M.** Muskeg evaporites of Western Canada and associated oil [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 536, 1968.

07142 **Knopoff, Leon.** Upper Mantle Project—Phase III, 1968–1970: Am. Geophys. Union Trans., v. 48, no. 2, p. 757–758, 1967.

The period 1968–70 has been designated Phase III of the Upper Mantle Project, a period for (1) analysis and interpretation of results from research already underway, and (2) elaboration of existing programs and development of new. The revised United States program for the Upper Mantle Project calls for more international cooperative studies, particularly with Latin America. Recommendations for Phase III of the project, adopted at the meeting in Tokyo in 1966, are quoted. Finally it is noted that a monograph on the crust and upper mantle, with contributions from a wide variety of international experts, is in preparation which will expand in depth the problems outlined in "Solid-Earth Geophysics—Survey and Outlook" published by the National Academy of Sciences.—DBV

Koerner, R. M. *See* Barr, W. 01516

06989 **Koppe, Edwin F.** Petrography of coal in the Houtzdale quadrangle, Clearfield County, Pennsylvania: Pennsylvania Geol. Survey, 4th ser., Bull. M55 (Mineral Resources Rept.), 73 p., illus., tables, 1967.

Medium and low volatile bituminous coals were studied by quantitative microscopic petrography and supplementary ash analyses to determine maceral composition, lateral continuity of composition, and usefulness of the analyses for detailed geological correlations. Data are presented for 9 coals from 92 sample sites. Each coal was sampled by layers, and bed totals are based upon percentage of macerals in each layer as well as percent contribution of the layer to the total coal. Conemaugh and Pottsville coal yield low vitrinoid values and high ash concentrations suggestive of marginally economic deposits. Petrography proved useful in establishing identity of some coals over more than four miles. Upper Freeport coal and some beds of the Lower Kittanning coal complex were readily identified by total coal composition; other beds were more variable and could be correlated only by means of individual layers within the beds.—*from* Author's abstract

01173 **Kottlowski, Frank E.** Late Paleozoic sediments derived from Pedernal uplift [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 537, 1968.

01174 **Kraft, John C.** Transgressive facies patterns in Delaware coastal area [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 537, 1968.

Kremp, G. O. W. *See* Traverse, A. 01651

01428 **Krizman, R. W.; Kruger, C. L.** Aeromagnetic map of the Kabetogama Lake–Grassy Lake area, St. Louis County, Minnesota: U.S. Geol. Survey Geophys. Inv. Map GP–616, scale 1:250,000, 1968.

01585 **Krogh, T. E.; Davis, G. L.; Aldrich, L. T.; Hart, S. R.; Stueber, A.** Geological history of the Grenville Province: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 528–536, illus., 1968.

Age measurements now provide a basis for major revision of time sequences in the Grenville. Past measurements on minerals yield values of 900±100 m.y., whereas geology suggests that the rocks are much older. The authors have obtained whole-rock Rb–Sr ages between 1500 and 2000 m.y. for rocks from Ontario; effect of the 900 m.y. event on the whole-rock system is being evaluated. Two granite bodies, emplaced at 1500 and 1700 m.y., establish two discrete events. Fundamental concepts of Rb–Sr dating are explained, and it is shown that the assumption that abundance of Sr–87 to Sr–86 was the same in all samples when the rock was formed is verified if data on a plot of Sr–87:Sr–86 vs. Rb–Sr lie on a straight line. Isochron plots for the French River granite and paragneiss, and a granite at Lake Muskoka, Ontario, are given, and sampling techniques and age results are discussed.—ESL

Kruger, C. L. *See* Krizman, R. W. 01428

Krusiewski, S. V. *See* Gabelman, J. W. 01617

01606 **Ku, Teh-Lung; Broecker, Wallace S.; Opdyke, Neil.** Comparison of sedimentation rates measured by paleomagnetic and the ionium methods of age determination: Earth and Planetary Sci. Letters, v. 4, no. 1, p. 1–16, illus., tables, 1968.

Rates of sedimentation based on Th–230 measurements for 14 deep-sea cores are compared with those derived from magnetic reversal studies on the same cores. The results are completely compatible. In some cases Pa–231 and C–14 dates are available; again the agreement is satisfactory. The average rate of accumulation of $CaCO_3$-free sediment based on our results is about 2 m per million years. Rates below one-half m per million years have not been found. This conclusion is at variance with that of Goldberg and his coworkers who find that rates less than one-half per million years are common in major portions of the oceans. This

discrepancy is shown to be largely the result of interpretation of Th-230 data. When "best" fit lines are substituted for the "steepest fits," the discrepancy largely disappears.—*from* Authors' abstract

06996 **Kugler, H. G.; Bolli, H. M.** Cretaceous biostratigraphy in Trinidad, W. I.: Asoc. Venezolana Geología, Minería y Petróleo Bol. Inf., v. 10, no. 8, p. 209–236, tables, 1967.

Near open-sea stages appear to have dominated the Cretaceous of Trinidad. In the Northern Range, the Lower Cretaceous Caribbean Group forms a great thickness of low grade metamorphosed rocks, typical of foredeep formations in which fossils are rare; massive reef limestones in its upper part contain fossils comparable to Urgonian facies of the Mediterranean region. In the Central Range, Upper Cretaceous layers include richly foraminiferal chalks and marls, with occasional mollusks. Most Cretaceous exposures in southern Trinidad are not in normal stratigraphic position, but form slump masses, allochthonous blocks, and conglomerates. Correlation is based on detailed subsurface core information obtained in exploration for oil. Fossils described by earlier workers are listed, their reported stratigraphic relations reviewed, and species distribution tabulated.—GDC

01552 **Kullerud, G.** High-temperature phase relations in the Cu–Fe–S system: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 404–409, illus., 1968.

A study is reported of the Cu–Fe–S system at 1100°, 1000°, and 900°C; results are shown in diagrams. Bornite solid solution can contain up to 12 percent Fe at 100°C; at 1077°C it is in equilibrium with Fe solid solutions containing about 10 percent Cu. Below 1067° Cu containing 2–3 wt percent Fe in solid solution coexists with bornite solid solution. Solubility of Cu in the pyrrhotite phase increases with decreasing temperature, to about 7.0 wt percent at 1000°C. At about 960°C the chalcopyrite phase crystallizes; on cooling the sulfur content of the chalcopyrite increases rapidly and the structure of the mineral can tolerate larger variations in Cu:Fe ratio. At about 813°C the ternary liquid field disappears.—MST

01553 **Kullerud, G.; Moh, G.** High-temperature phase relations in the Cu–Ni–S system: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 409–413, illus., 1968.

Phase relations for the system Cu–Ni–S are shown in diagrams for 1200°, 780°, and 700°C. At 1200°C two large fields of liquid immiscibility exist, but diminish rapidly at lower temperatures. Chalcocite appears at 1105°, vaesite (NiS_2) at 1007°, $Ni_{3\pm x}S_2$ at 806°. Chalcocite and vaesite are in equilibrium below 770°, chalcocite and $Ni_{1-x}S$ below 760°, and chalcocite and $Ni_{3\pm x}S_2$ below 720°.—MF

Kullerud, G. *See* Craig, J. R. 01554

Kullerud, G. *See* Craig, J. R. 01559

Kullerud, G. *See* Craig, J. R. 01562

01563 **Kullerud, G.; Bell, P. M.; England, J. L.** High-pressure differential thermal analysis of CuS: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 442, illus., 1968.

The condensed Cu–S system is complex at low temperatures, and phase relations become increasingly complex under high confining pressures. Melting relations of covellite to 11 kb were investigated by high pressure DTA, and the results plotted on a diagram with data from 1965 low pressure tests. The P–T curve for the covellite⇌digenite+liquid (gas) reaction has a positive slope of about 10°C per kb.—ESL

01564 **Kullerud, G.; Yoder, H. S., Jr.** Sulfide-silicate relations: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 442–446, 1968.

Experiments have been performed to test the hypothesis that silicate and sulfide liquids coexist at elevated temperatures and to investigate the mutual solubilities among these liquids. The first test, to ascertain relations between a natural granite

and mixtures of sulfides commonly associated with granitic rocks, in the presence of H_2O at 5 kb, showed that under natural conditions a rock magma of granitic composition could coexist with a sulfide liquid. The second series of tests, involving ferrogabbro from the Skaergaard intrusion and pyrrhotite, showed that ferrogabbro liquid coexists with magnetite and pyrrhotite. It is believed that the underlying principle relating specific ore deposits to specific rock types is a result of partition of metals to sulfur and silicate.—ESL

01578 **Kullerud, G.; Donnay, Gabrielle; Donnay, J. D. H.** Omission solid solution in magnetite: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 497–498, illus., 1968.

In the structure of iron-deficient magnetite, produced by heating magnetite powder and sulfur, vacancies occupy centers of oxygen tetrahedra and octahedra. Distribution between the positions depends on temperature of the reaction, and determines properties such as density, color, magnetic susceptibility, and thermodynamic stability. Cell edge a is not uniquely defined by composition, but is a function of z, total number of vacancies, and y, number on tetrahedral sites. A nomogram for Alaska magnetite and three experimental samples show that the cell edge of pure Fe_3O_4, $a=8.397$ decreases on oxidation if vacancies are on octahedral sites, but increases if they occupy tetrahedral sites. The surface of density as a function of y and z is shown by contour lines on the graph.—ESL

01580 **Kullerud, G.; Donnay, J. D. H.; Donnay, Gabrielle.** Cross-twinning as a mechanism of phase transition: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 503–504, 1968.

Experiments indicate that marcasite and pyrite are not polymorphs. Natural marcasite from Joplin, Mo., showing typical anisotropism and very infrequent twinning, was heated with water at various temperatures. After five days, at 2 kb and 350°C, twinning in one direction is common; after a week, twinning occurs in two directions in all grains; after two weeks, all grains are highly cross-twinned and pyrite occurs at the intersection of twin lamellae; after three weeks, the samples are almost entirely pyrite, powder patterns of which are different from those commonly observed. In both pyrite and marcasite, the twin plane (110) is a twin glide plane. The twinning of marcasite that precedes transition to pyrite demonstrates clearly the role of cross-twinning as the transition mechanism.—ESL

01503 **Kumar, A.** The effect of stress rate and temperature on the strength of basalt and granite: Geophysics, v. 33, no. 3, p. 501–510, illus., 1968.

The ultimate strengths of basalt and granite were measured over a range of stress rates from 2×10 to 3×10^{10} psi per sec. The static strengths of basalt and granite were 27.5 and 29 kpsi respectively at the stress rate of 2×10 psi per sec and 59 and 70 kpsi at the stress rate of 3×10^{10} psi per sec. To obtain insight into basic mechanisms of rock fracturing, the combined effects of stress rate and temperature were studied. Strength of basalt was increased from 27.5 kpsi at room temperature to 45 kpsi at liquid nitrogen temperature at the stress rate of 2×10 psi per sec; mechanisms of fracturing were thermally activated. The activation energy for basalt at 50 kpsi equalled 450 calories per mole. The dynamic modulus of basalt measured by the pulse technique was 1.7×10^7 psi. The value of the dynamic modulus obtained at a stress rate of 3×10^8 psi per sec was 2.2×10^7 psi.—*from* Author's abstract

01347 **Lacey, James Edward.** Criteria for the distinction of autochthonous from allochthonous oolites—Application to the Ste. Genevieve Limestone (Valmeyeran, Mississippian), southern Illinois [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 8, p. 3339B–3340B, 1968.

Lacey, W. S. *See* Banks, H. P. 07070

01441 **Ladd, George T.** ESCP—An investigative approach for teaching earth science to students of all levels of ability: Jour. Geol. Education, v. 16, no. 2, p. 61–64, illus., 1968.

The Earth Science Curriculum Project of the American Geological Institute and its investigative approach can be presented successfully to students of diverse abilities. The response of above- and below-average 9th grade students to a problem-solving approach over a two-year period is discussed. Both groups grew in scientific maturity, confidence, and ability to think, reason, and apply observations.—GDC

01468 **Lajoie, J.; Lespérance, P. J.; Béland, J.** Silurian stratigraphy and paleogeography of Matapedia-Témiscouata region, Quebec: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 4, p. 615–640, illus., 1968.

The Silurian System overlies the Cambro-Ordovician with angular unconformity. In the northeast and central parts of the region sedimentation continued from Silurian into Devonian time, but in the southwest part a disconformity apparently exists. The Early Silurian sea transgressed from northeast to southwest. Deposition of terrigenous sediments was followed by deposition of sediments of volcanic origin derived from the south-southeast. Llandoverian sediments are characteristic of a rapidly sinking trough, Wenlockian sediments are indicative of a shallow-marine environment, and Ludlovian and "Skalian" sediments suggest a more rapidly sinking trough.—WLA

07143 **Lajtai, Emery Zoltan.** The influence of interlocking rock discontinuities on compressive strength (model experiments) [with German summ.]: Felsmechanik u. Ingenieurgeologie, v. 5, no. 4, p. 217–228, illus., 1967.

The first stage of an experimental investigation of the stability of discontinuous rocks has concentrated on the influence of those planes of weakness in which discontinuity strength is due to interlocking. Plaster of Paris specimens containing single planes of weakness have been subjected to uniaxial compression. The inclination of joints varied from 30–50°, and the average width of the interlocking teeth from 1/4 to 1 1/8 in. A significant reduction in strength is noticeable as the width of the teeth is reduced to less than 3/4 in. Above this size the compressive strength becomes independent of tooth-width. Interpreted values of tangential and normal stresses when plotted in Mohr's stress plane, indicate a linear relationship for samples with a 1-in. tooth and a curved one for specimens with a 1/4-in. tooth.—KAS

Lam, Jörgen. *See* Pedersen, K. Raunsgaard. 01685

Lamar, J. E. *See* Hunter, Ralph E. 01465

07006 **Lämmerzahl, P.** Rare-gas isotope studies on meteorites, *in* Mantles of the Earth and terrestrial planets (S. K. Runcorn, editor): London and New York, Interscience Publishers, p. 49–61, illus., table, 1967.

Rare gases reveal three stages of isotopic change in meteorites. Primordial rare gases with solar isotope abundance ratios have been localized close to crystal surfaces by microprobe analysis. After sufficient cooling of the parent body radiogenic isotopes started to accumulate. Advantages and possible sources of error in radiogenic age measurement with noble gases are reviewed. Break-up of the parent body exposed meteorites to cosmic radiation from which exposure ages can be derived. Stony meteorites are younger than the irons by more than an order of magnitude, which suggests that they came from different places in the solar system.—JPF

06962 **Lane, N. Gary.** Revision of suborder Cyathocrinina (Class Crinoidea): Kansas Univ. Paleont. Contr.—Paper 24, 13 p., illus., 1967.

Cyathocrinina is divided into three superfamilies, Palaeocrinacea, Cyathocrinitacea, and Codiacrinacea. The first two superfamilies differ by absence and presence, respectively, of an anal sac; each includes closely related families. Codiacrinacea, n. superfam., comprises the former family Codiacrinidae, here divided into three families. Codiacrinidae, restricted, includes Devonian to Permian genera with five arm-bearing radials. Sycocrinitidae, n. fam., includes Mississippian to Permian genera that have only the *D* radial bearing an arm, the other radials being either

present or absent. Streblocrinidae, n. fam., includes armless crinoids in which the radials disappeared during the Devonian, and pseudomonocyclic genera without radials which continue into the Permian.—*from* Author's abstract

06963 **Lane, N. Gary; Webster, G. D.** Symmetry planes of Paleozoic crinoids: Kansas Univ. Paleont. Contr.—Paper 25, p. 14–16, illus., 1967.

The homocrinid (*E–BC*) plane of bilateral symmetry in the crown of some monocyclic inadunate and flexible crinoids is postulated to be a relict expression in adults of the dorso–ventral symmetry plane of the doliolarian, free–swimming, larval stage.—Authors' abstract

Langway, C. C., Jr. *See* Oeschger, H. 06997

07069 **Lanning, F. C.; Kimbrough, Charlotte.** Iron II and iron III in Cottonwood Limestone: Kansas Acad. Sci. Trans., v. 70, no. 1, p. 67–70, table, 1967.

The Cottonwood Limestone, a member of the Beattie Formation, of Permian age, is five to seven feet thick and has three distinct layers. Analyses were made to determine the vertical variability in ferrous and ferric iron in the formation in Riley County, Kansas; data are presented in a table. The percentage of total iron and Fe^{+2} are highest at the lowest level and decrease upward. The iron content is lowest in the fusulinid–bearing beds. The lower percentages of iron present could be due to differential rates of sedimentation.—HRC

01442 **Larsen, Frederick D.** A tank for demonstrating alluvial processes: Jour. Geol. Education, v. 16, no. 2, p. 53–55, illus., 1968.

A narrow, portable sedimentation tank was designed to demonstrate the formation of an alluvial fan and delta to a physical geology class. Additional phenomena—headward erosion, turbidity currents, and graded bedding—prove to be of greater value than those for which the tank was originally designed.—Author's abstract

01410 **Laurence, Robert A.; Ericksen, George E.** Economic geology, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 51–55, tables, 1968.

An extremely cursory review of the mineral resources of Appalachia are given; no details are included.—HRC

01431 **Lee, Milford R.** Vibroseis [abs.], *in* Sources of seismic energy for marine exploration, Pt. 1: Ocean Industry, v. 3, no. 5, p. 36–37, illus., 1968.

07137 **Lees, John A.** Stratigraphy of the Lower Ordovician Axemann Limestone in central Pennsylvania: Pennsylvania Geol. Survey, 4th ser., Bull. G52 (General Geology Rept.), 79 p., illus., tables, 1967.

The Axemann Formation includes calcirudite; pelmatozoan, lithic, oolitic, and fine–grained calcarenites; calcilutite; and structureless, laminated, and mottled fine, medium, and coarse crystalline dolomite. In the Bellefonte–State College area, it is divided into two members, herein named the Half–Moon Hill and Rockview Members. South of State College, the Axemann is represented by the equivalent of the Rockview Member only. The formation crops out in northeast–southwest trending belts and grades laterally into dolomite. Many environmental changes are represented by the different rock types. Included in the report are photomicrographs of thin sections, illustrated fossils, locations of 29 measured sections and descriptions of three, and six cross sections.—ESL

01676 **LeGrand, Harry E.** Monitoring of changes in quality of ground water: Ground Water, v. 6, no. 3, p. 14–18, illus., 1968.

Ground water of acceptable quality is commonly interspersed with water of inferior quality—salty water underlying fresh water, or enclaves of contaminated water lying in the fresh–water bodies. Migration of contaminated water toward wells may result from the natural hydraulic gradient, or be induced by the cone of depression around

wells. No economic method of determining the boundary zone between contaminated and uncontaminated water is known and reliance is placed on monitoring wells. A prerequisite to this is a synthetic hydrogeologic model in which behavior of the contaminated water is conceived. Such a model helps to assess the need for monitoring and to guide a program. Need for monitoring will increase in the future; yet the objective is to improve the technology of determining distribution of contaminated water so that monitoring can be minimized and conducted with optimum results.—*from* Author's abstract

Lespérance, P. J. *See* Lajoie, J. 01468

07051 **Lesser Jones, Heinz.** Confined fresh water aquifers in limestone, exploited in the north of Mexico with deep wells below sea level [with French abs.], *in* Hydrology of fractured rocks—Dubrovnik Symposium, 1965, Proc., V. 2: Internat. Assoc. Sci. Hydrology Pub. 74, p. 526–539, illus., 1967.

In ranges of the Eastern Sierra Madre, in its extensions to the Central Plateau, and to the Coastal Plain of the Gulf of Mexico, are steeply folded mountains of marine (mainly Cretaceous) sediments, mostly series of shales and limestone, with a thickness of more than 5,000 m. The limestones, persistent and pervious, with a total thickness of about 1,000 m, constitute in certain regions, aquifers of great productive capacity. Several cities in northern Mexico exploit these aquifers by about 50 wells with depths from 200–1,400 m; wells or well fields have been located on flanks and axes of anticlines to reach the aquifers at the least possible depth. The aquifers have seasonal variations in levels regardless of production, deduced transmissibility and storage capacity are high, and effects of recharge of the isolated rains are nearly instantaneous.—*from* Author's abstract

01327 **Lesure, F. G.; Feitler, Stanley A.; Stansfield, Robert G.** Feldspar, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 277–280, tables, 1968.

Feldspar occurs in all of the pegmatite districts of the Blue Ridge and Piedmont in Appalachia, but most is mined from the large, fine-grained pegmatite of alaskite bodies in the Spruce Pine district of North Carolina. A brief description of the deposits is given, although no new information is included.—HRC

01369 **Lesure, F. G.; Shirley, L. E.** Mica, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 311–325, illus., table, 1968.

A cursory description of the occurrence and origin of mica in Appalachia is given; most comes from North Carolina, where the deposits are the largest in the country.—HRC

Levin, S. Benedict. *See* Schwering, Felix K. 01679

01626 **Liao, K. H.; Scheidegger, A. E.** A computer model for some branching-type phenomena in hydrology: Internat. Assoc. Sci. Hydrology Bull., v. 13, no. 1, p. 5–13, illus., tables, 1968.

In hydrology, branching-type phenomena occur in several instances, for example, in ground-water flow (splitting flow channels in a porous medium) and in the formation of a natural river network (combining, i.e., inverse branching, of small rivers to form large rivers). Such phenomena can be treated by the statistics of topological bifurcating arborescences. It is shown how ensembles of arborescences can be generated on a computer and expectation values for observables can be calculated. In this fashion, the laws of dispersion processes in flow through porous media and Horton's law of stream numbers in drainage basins are shown to be the outcome of very simple statistical assumptions.—Authors' abstract

01539 **Lindsley, D. H.; Brown, G. M.; Muir, I. D.** Hedenbergite–wollastonite inversion in a Skaergaard pyroxene: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 359–363, illus., 1968.

The rocks formed during the late states of fractionation of the Skaergaard intrusion of Greenland contain hedenbergitic pyroxenes, some of whose textures suggest that they have inverted from ferriferous wollastonite solid solutions. The results of experiments on an analyzed, inverted ferriferous wollastonite from the Skaergaard intrusion, combined with data on the quartz–tridymite inversion indicate that some Upper Zone rocks of the intrusion crystallized at 600±100 bars, over a temperature range spanning the value 970°±20°C.—MST

01541 **Lindsley, D. H.; Munoz, J. L.** Subsolidus relationships in part of the hedenbergite–ferrosilite join at low pressures: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 363–366, illus., 1968.

The authors have investigated the subsolidus relations of part of the hedenbergite–ferrosilite join at pressures from 0 to 2 kb. It appears that a portion of the Bowen–Schairer–Posnjak metasilicate diagram reflects metastable conditions; the authors find that the composition of synthetic hedenbergite solid solution in equilibrium with fayalite+quartz is very close to that from the iron-rich portions of the Skaergaard and Bushveld intrusions. The reaction pertinent to this problem is Fs-rich hedenbergite = Fs-poor hedenbergite + fayalite + quartz.—MST

Lindsley, D. H. *See* Dundon, Robert. 01542

01572 **Lindsley, D. H.; Emslie, R. F.** Effect of pressure on the boundary curve in the system diopside–albite–anorthite: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 479–480, illus., 1968.

Previous studies suggesting a shift of the diopside–plagioclase boundary under pressure are reviewed. High-pressure experiments on one composition, $Ab_{32.6}An_{32.6}Di_{34.8}$, in the diopside–albite–anorthite system were carried out to test the boundary-shift hypothesis. It is concluded that although the shift of the boundary curve with increasing pressure is in the right direction, the magnitude of the shift in the absence of water is too small to make this a likely mechanism for the generation of gabbroic anorthosites.—ESL

01175 **Ling, Hsin-Yi.** Radiolaria in surface sediments of northeast Pacific Ocean [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 538, 1968.

Lloyd, A. J. *See* Banner, F. T. 07074

01506 **Longinelli, A.; Nuti, S.** Oxygen-isotope ratios in phosphate from fossil marine organisms: Science, v. 160, no. 3830, p. 879–882, illus., table, 1968.

Well-preserved fossil marine organisms generally yield very positive δ O-18(PO_4^{3-}) values which are considered to result from relatively good preservation of the original oxygen-isotope composition of phosphatic material deposited under isotopic equilibrium conditions in oceanic water whose O-18:O-16 ratio was more positive than that of modern oceans.—Authors' abstract

Lowry, Marlin E. *See* Whitcomb, Harold A. 01645

01430 **Luehrmann, W. H.** Sparker system [abs.], *in* Sources of seismic energy for marine exploration, Pt. 1: Ocean Industry, v. 3, no. 5, p. 37–39, illus., 1968.

01348 **Lumbers, Sydney Blake.** Stratigraphy, plutonism, and metamorphism in the Ottawa River remnant in the Bancroft–Madoc area of the Grenville Province of southeastern Ontário, Canada [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 8, p. 3340B, 1968.

01429 **Luskin, Bernard.** PAR Air Gun [abs.], *in* Sources of seismic energy for marine exploration, Pt. 1: Ocean Industry, v. 3, no. 5, p. 39–41, illus., 1968.

01573 **Luth, W. C.** The influence of pressure on the composition of eutectic liquids in the binary systems sanidine–silica and albite–silica: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 480–484, illus., 1968.

In preliminary experiments on albite–silica and sanidine–silica systems at pressures between 8 and 20 kb, the solidus for each system was located within 25°C. Equilibrium was not attained during the experiments, but its direction was obtained. Over the P–T range studied, quartz is the participating silica phase. Results indicate a marked effect of pressure on composition of eutectic liquids. It appears unlikely that effects of water pressure and of water as a component can be treated separately in experimental studies of crystallization of water–undersaturated granitic magmas. Isobaric temperature–composition diagrams and P–T and P–X projections are included.—ESL

01330 **Luttrell, Gwendolyn W.; Stansfield, Robert G.** Silver, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 426–430, illus., tables, 1968.

Silver production from Appalachia has come entirely from Tennessee and North Carolina where silver occurs as an impurity in sulfide ores; extremely brief descriptions of the general occurrence are given.—HRC

01349 **Lyons, David James.** Structural geology of the Boulder Creek metamorphic terrane, Ferry County, Washington [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 8, p. 3340B–3341B, 1968.

07014 **Lytle, William S.; Heyman, Louis; Wagner, Walter R.** Oil and gas developments in Pennsylvania in 1966: Pennsylvania Geol. Survey, 4th ser., Prog. Rept. PR 173, 51 p., illus., tables, 1967.

Exploratory drilling in Pennsylvania in 1966 resulted in the discovery of three deep Oriskany sandstone pools, Kidders Corner and Springfield pools in Erie County, and Seven Springs pool in Somerset County, one shallow Upper Devonian gas field, and one shallow Upper Devonian oil pool. Development drilling extended several oil and gas fields and pools; development of shallow areas, begun in 1965, was continued. Of 74 exploratory tests drilled, 28 were successful. Production in 1966 was 4,337,000 bbls of oil, down from 1965, and 91,365,000 MCF of gas, up from 1965. Proved oil reserves are estimated at 72,429,000 bbls and gas reserves at 1,350,576,000 MCF.—ESL

06981 **Macdonald, J. R.** The *Tyrannosaurus* search goes on: Los Angeles County Mus. Nat. History Quart., v. 5, no. 3, p. 12–14, illus., 1967.

This is a brief and very informal account of discovery and excavation of dinosaur skeletons in Late Cretaceous strata of eastern Montana during the Museum's 1966 summer project. *Triceratops* and *Trachodon* skeletons were found, but no *Tyrannosaurus*.—VMJ

Mackenzie, Fred T. *See* Upchurch, Sam B. 01203

01448 **MacQuown, W. C., Jr.; Thomas, Franklin D.** Clay models simulate geologic structural and stratigraphic features: Jour. Geol. Education, v. 16, no. 2, p. 69–71, illus., 1968.

Students usually understand map interpretations better if they make and interpret actual three dimensional models in laboratories to supplement presentation of block diagrams in lecture. Small plasticene clay models can be cut with a knife or wire in any direction to enhance visualization of surfaces and cross sections. Various folds and fault types can be formed, igneous intrusions inserted, and erosion processes performed with a knife; stratigraphic models can illustrate facies changes and variation in thickness. The principal innovation, to obtain subsurface structural and stratigraphic information, is the technique of coring clay models, described herein in detail. Structural contour and isopachous maps can be constructed on the basis of such cores spaced on a model about 10″×10″, 1″ to 2″ thick, a suitable size for a class of 20 students.—GDC

Macurda, Donald B., Jr. *See* Beaver, Harold H. 07125

Major, R. L. *See* Bradbury, J. C. 01518

01627 **Major, Robert L.** Mineral resources and mineral industries of the northeastern Illinois region: Illinois Geol. Survey Mineral Economics Brief 22, 28 p., illus., tables, 1968.

The value of mineral production in these six counties—Cook, DuPage, Kane, Lake, McHenry, and Will—in 1966 was 66.1 million dollars. Minerals and products produced include limestone and dolomite, sand and gravel, and clay products. The area contains feldspar-bearing sands, not used at present, but probably usable in the future if certain beneficiation problems are solved. The area is the largest and most diversified mineral processing region in the state.—*from* Author's abstract

Manchee, E. B. *See* Anglin, F. M. 01686

Manistre, Bernard L. *See* Swift, Donald J. P. 01417

06992 **Marcus, Melvin G.** Introductory physical geography in the college curriculum, *in* Introductory geography—Viewpoints and themes: Assoc. Am. Geographers Comm. Coll. Geography Pub. 5, p. 1–14, 1967.

In discussing curriculum reform, the author presents his views on the place, purpose, and content of introductory college geography, with particular emphasis on physical geography. Introductory courses serve two purposes: they offer basic training to students who will continue in the field, and provide a larger group with insights into a new body of knowledge. Physical geography is defined in quotations from Kalesnik (1964) and Wolman (1965). Important concepts and subject materials suggested are: dimension, measurement, and location; projections and maps; energy, momentum, and moisture; regional climatology; geomorphology; and soils and vegetation. The suggestion is made that a general introductory course should be followed by introductory courses in physical and human geography.—ESL

01363 **Marland, Frederick Charles.** The history of Mountain Lake, Giles County, Virginia—An interpretation based on paleolimnology [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 8, p. 3529B, 1968.

01176 **Martini, I. P.** Grain-orientation and paleocurrent systems in Medina Formation [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 540, 1968.

Martini, Jacques. *See* Cuénod, Yves. 06980

01507 **Mason, Brian; Jarosewich, E.** Denver meteorite—A new fall: Science, v. 160, no. 3830, p. 878–879, 1968.

A meteorite, a single stone weighing 230 gm, was discovered in the roof of a warehouse on July 17, 1967. Evidently it fell during the preceding week. The warehouse is on the northeast edge of Denver, Colo.; coordinates, 39°46′57″ N., 104°55′50″ W. This is the first recovered fresh fall in the United States since the Bells (Texas) meteorite of September 9, 1961. The composition and structure are those of an olivine-hypersthene chondrite.—Authors' abstract

01519 **Mast, R. F.; Shimp, N. F.; Witherspoon, P. A.** Geochemical trends in Chesterian (Upper Mississippian) Waltersburg crudes of the Illinois Basin: Illinois Geol. Survey Circ. 421, 27 p., illus., tables, 1968.

Twenty-five samples of crude oil and 11 core samples of Waltersburg shale were spectrochemically analyzed for traces of nickel and vanadium; light hydrocarbon components were determined in 14 of the crude oil samples by gas chromatography. Indirect evidence, based primarily on the relationship between Waltersburg oil occurrence and faulting, suggests that these crudes came from older sediments. Strong regional trends in their trace metal contents parallel the primary sediment transport direction in the ancient basin. Almost random variations were found in the naphthene and aromatic contents of crudes entrapped in isolated Waltersburg sand bodies in southeastern Illinois. No regional trends were identified in the trace

metal content of the shales, but their concentration ratios of Ni:V were similar. The trace metals in shales were like those in the crudes.—*from* Authors' abstract

Mattick, Robert E. *See* Oliver, Howard W. 01419

01387 **Maxwell, Charles H.; Frendzel, Donald J.; Stansfield, Robert G.** Sand and gravel, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 254–260, illus., tables, 1968.

A cursory description of the occurrence of sand and gravel in Appalachia is given; no new data are included, however. The deposits are fluvial, glacial, and residual; each type is discussed briefly.—HRC

01499 **Maxwell, Ross A.** The Big Bend of the Rio Grande—A guide to the rocks, landscape, geologic history, and settlers of the area of Big Bend National Park: Texas Univ. Bur. Econ. Geology Guidebook 7, 138 p., illus., table, geol. map, 1968.

A complete geological description of the National Park is given in this semipopular guide to the region. Rocks of undifferentiated Paleozoic to Tertiary and Quaternary age are shown on a map and described. Details of the origins of various geomorphic features are included, along with an account of the general human history of the region.—HRC

07028 **Mayou, Taylor V.** Paleontology of the Permian Loray Formation in White Pine County, Nevada: Brigham Young Univ. Geology Studies, v. 14, p. 101–122, illus., tables, 1967.

The Loray Formation contains one of the most profuse mollusk faunas in the Great Basin; exceptional exposures are on Butte Mountain, northwest of Ely. The formation is about 1,900 feet thick; its base contains mostly brachiopods, crinoid ossicles, and bryozoans; abundant mollusks are in the middle and upper parts, and ostracodes occur throughout. Eight gastropods, four pelecypods, two nautiloids, two Bryozoa, one brachiopod, one echinoid spine, one scaphopod, and two ophiuroids (one of which is new) are described. The formation on Butte Mountain shows a change from a normal marine environment to a hypersaline, shallow water environment.—*from* Author's abstract

01177 **Mayuga, M. N.** Geology of California's giant—Wilmington oil field [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 540, 1968.

01461 **McCrone, Alistair W.** Short-lived radionuclides and weathering: Jour. Sed. Petrology, v. 38, no. 1, p. 252–253, 1968.

Short-lived radionuclides (e.g. S-35), constantly produced by cosmic ray spallation reactions in the atmosphere, are believed to be noteworthy in the geochemistry of weathering over long periods of geologic time.—Author's abstract

McDaniel, P. N. *See* Pray, L. C. 01185

01687 **McGauhey, P. H.** Manmade contamination hazards: Ground Water, v. 6, no. 3, p. 10–13, 1968.

Hazards to ground water may result from adding to water which may infiltrate the soil, or to the soil through which water percolates, wastes from man's life processes, his industrial and commercial activity, or his use of water, fertilizers, and pesticides in agriculture. Particulate matter does not move far with percolating water in a soil system. The effect of domestic use of water is generally to increase the concentration of salts normally present in such waters. From the vast spectrum of compounds produced by the chemical industry come hazards to ground-water quality such as metal ions, phenols, tar residues, brines, and exotic organics. Mineralization with nutrients and soluble soil fractions, and possibly, pesticide residues are the hazards from agricultural use. It is concluded that the most serious hazard is the buildup of dissolved solids to levels inimical to beneficial use.—*from* Author's abstract

07120 **McGlade, William G.** Oil and gas geology of the Amity and Claysville quadrangles, Pennsylvania: Pennsylvania Geol. Survey, 4th ser., Bull. M54 (Mineral Resources Rept.), 131 p., illus., tables, 1967.

These quadrangles, in Washington County, were once sites of intensive oil and gas development, the Washington–Taylortown oil field ranking as one of the largest in the State. Since the end of the 19th century drilling and production have declined to a near-marginal enterprise. Reservoirs have not been developed with the new exploratory and completion techniques that have rejuvenated other areas. At least 22 productive or potential reservoirs exist, and areas of more prolific horizons are outlined on maps; all known wells are located. Appendixes contain core analyses and descriptions, descriptions of samples, selected well records from each quadrangle, and analyses of five oil samples. A fence diagram of the Upper Devonian and Mississippian, a selected log of productive rocks, a cross section in Washington–Greene–Fayette Counties, and a structure contour map accompany the report.—ESL

01178 **McGregor, A. A.; Biggs, Charles A.** Bell Creek field, an embryonic giant, Powder River and Carter Counties, Montana [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 541, 1968.

01666 **McIlwaine, W. H.** Milner township, District of Timiskaming: Ontario Dept. Mines Prelim. Geol. Map P. 475, scale 1 in. to 1/4 mi., text, 1968.

The only Archean rocks in Milner township are represented by two small windows of intermediate to mafic metavolcanic flows, tuffs, and agglomerate. Unconformably overlying the basement are the sedimentary rocks of the Cobalt Group—Coleman, Firstbrook, and Lorrain Formations. Intruding all the older rocks is the Nipissing-type quartz diabase sheet. The Cobalt rocks generally have gentle dips to the east; bedding becomes disrupted where it has been disturbed by faulting. The only significant mineralization, native silver with associated cobalt-nickel arsenides, is confined to calcite veins in or very close to Nipissing diabase.—MCM

07009 **McKenzie, D. P.** The mantle as an Einstein solid [abs.], *in* Mantles of the Earth and terrestrial planets (S. K. Runcorn, editor): London and New York, Interscience Publishers, p. 111, 1967.

01616 **McMahon, B. E.; Strangway, D. W.** Investigation of Kiaman magnetic division in Colorado redbeds: Royal Astron. Soc. Geophys. Jour., v. 15, no. 3, p. 265–285, illus., tables, 1968.

Paleomagnetic examination of Middle and Upper Pennsylvanian, Permian and Triassic redbeds from the western and eastern slopes of the Colorado Front Range suggests a late Pennsylvanian–Permian reversed interval equivalent to the Kiaman magnetic interval on the North American continent. Collections made from a stratigraphic interval of 2,000 feet on the eastern slope and 4,000 feet on the western slope showed reversed directions only. Available stratigraphic data indicate that the zone extends from the beginning of Late Pennsylvanian to Late Permian or into Early Triassic. It appears that the redbeds acquired their magnetic direction at the time of deposition or very soon thereafter. Calculated paleomagnetic poles are: Middle Pennsylvanian, 39° N., 105° E.; Upper Pennsylvanian and Permian, 33° N., 126° E., for the western slope and 48° N., 119° E., for the eastern slope; Lower Triassic, 56° N., 100° E.—*from* Authors' abstract

01610 **McMurtry, Wilbur.** Memorial—Everett Carpenter [1884–1968]: Shale Shaker, v. 18, no. 8, p. 177–180, portrait, illus., 1968.

01179 **McNulty, C. L., Jr.; Slaughter, Bob H.** Teeth of Cretaceous batoid genus, *Ptychotrygon* [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 541, 1968.

01644 **Meisler, Harold; Becher, Albert E.** Carbonate rocks of Cambrian and Ordovician age in the Lancaster quadrangle, Pennsylvania: U.S. Geol. Survey Bull. 1254-G, p. G1–G14, illus., tables, 1968.

Carbonate rocks of Cambrian and Ordovician age in Lancaster quadrangle are divided into 14 rock-stratigraphic units, defined primarily by relative proportions of limestone and dolomite. Oldest units—Cambrian age Vintage, Kinzers, and Ledger Formations, and Ordovician age Conestoga Limestone—are retained. Cambrian Zooks Corner Formation (dolomite) is named for exposures along Conestoga Creek. Cambrian Conococheague and Ordovician Beekmantown Limestones, elevated to group rank and subdivided into formations correlated with and named for units in Lebanon and Berks Counties are, from oldest to youngest, Buffalo Springs, Snitz Creek, Millbach, and Richland Formations of the Conococheague, and Stonehenge, Epler, and Ontelaunee Formations of the Beekmantown. Annville and Myerstown Limestones overlie the Beekmantown in one small area.—*from* Authors' abstract

01180 **Meister, Frederic H.** Migration of oil and development of Permian basin as shown by carbon isotopic composition of oil [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 541, 1968.

01435 **Mencher, Ely; Copeland, R. A.; Payson, H., Jr.** Surficial sediments of Boston Harbor, Massachusetts: Jour. Sed. Petrology, v. 38, no. 1, p. 79–86, illus., 1968.

Composition, grain-size distribution, and organic content are reported for 152 grab samples of very poorly sorted black mud to sandy mud that forms the superficial sediments of Boston Harbor. Coarsest sediment occurs in dredged or tidal channels. Detrital material is from harbor islands; organic matter is indicated to be mainly of industrial origin or from sewage.—*from* Authors' abstract

07116 **Merriam, Daniel F.** (editor). Computer applications in the earth sciences—Colloquium on time-series analysis: Kansas Geol. Survey Computer Contr. 18, 77 p., illus., tables, 1967.

This is the third colloquium which has been held on the University of Kansas campus, for the interchange of ideas and discussion of research progress in computer applications in the earth sciences. The first dealt with classification procedures, the second with trend analysis (Computer Contributions 7 and 12, 1966 and 1967). Of fifteen contributors in different disciplines, 12 papers and 2 abstracts are cited individually [*See* Abstracts of North American Geology, September 1968].—GDC

01350 **Metz, Robert.** Stratigraphy and structure of the Cambridge quadrangle, New York [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 8, p. 3341B, 1968.

01579 **Meyer, H. O. A.; Donnay, Gabrielle; Donnay, J. D. H.** Relative orientations of intergrown crystals: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 498–502, illus., table, 1968.

Several authors have found that the diamond host affects the habit of olivine inclusions and that there is an orientation relation between host and inclusions; a technique using the precession camera to determine this relation is described. Interpretation of an orientation photograph of a diamond crystal with two forsterite inclusions is discussed and diagrammed.—ESL

01589 **Meyer, H. O. A.; Bell, P. M.; England, J. L.** High-pressure, high-temperature X-ray diffraction: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 541–544, illus., 1968.

A new apparatus, with a boron carbide pressure vessel, is particularly suited to study of single-crystal or polycrystalline nonquenchable phases up to 1000°C and about 25 kb, and can be used to examine the effect of pressure on thermal expansion of minerals; it is a substantial modification of a design by Meyer in 1966. Patterns can be obtained by powder or oscillating single crystal techniques at 2θ angles ranging from 0° to 160°. The apparatus can be mounted on an X-ray goniometer head, Weissenberg camera, or diffractometer. The device was tested at ambient temperature by examination of the compressibility of Solenhofen limestone.—ESL

01565 **Meyer, Henry O. A.** Mineral inclusions in diamonds: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 446–450, illus., table, 1968.

Inclusions in diamonds are interesting as possible samples of upper mantle. New data obtained by an electron microprobe is presented. Primary inclusions are olivine, orthopyroxene, clinopyroxene, garnet, spinel, coesite, and iron–nickel sulfides, all occurring as minute discrete crystals. The presence of coesite gives an upper limit to pressure involved in formation of the diamond. There are many similarities between the inclusions and primary minerals in kimberlite nodules; the main differences being the presence of coesite and muscovite in diamond. The relative uniformity of composition and limited number of elements observed are striking.—ESL

01395 **Meyer, Richard F.; Sweeney, John W.** Asphalt, heavy crude oil, and shallow oil reservoirs, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 96–101, illus., tables, 1968.

A cursory description of the occurrence of these materials in Appalachia is given. The data are summarized in tables, and no new information is included.—HRC

01399 **Meyer, Richard F.; Edgerton, Curt D., Jr.** Petroleum and natural gas, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 145–163, illus., tables, 1968.

This is an extremely brief review of the occurrence and origin of petroleum and gas in Appalachia; no new information is included.—HRC

Meyerhoff, A. A. *See* Paine, William R. 01436

01440 **Meyerhoff, Howard A.** Graduate training in geology: GeoScience News, v. 1, no. 4, p. 16–19, 30, illus., 1968.

The first-year graduate class is a polyglot group with uneven background training and diverse outlook. Applied mathematics, physics, and chemistry need to be taught with geology to be most useful and waste least time, as well as a first-year graduate orientation course. Before the graduate student can enter intelligently into the specialization that normally accompanies or precedes fruitful research, he must know the basic principles of geologic science and the use of tools that will facilitate any project he may undertake. This background prescribes the curriculum for his early graduate years.—ESL

Middlemiss, F. A. *See* Ager, D. V. 07073

Middleton, Gerard V. *See* Onions, Diane. 01471

Milici, Robert C. *See* Stearns, Richard G. 07094

01433 **Miller, Barry B.; Feldmann, Rodney M.** An integrated approach to teaching historical geology laboratories: Jour. Geol. Education, v. 16, no. 2, p. 43–46, illus., 1968.

The materials normally covered in historical geology laboratory—fossils, sedimentary rocks, geologic maps, etc.—have been worked into an integrated series of six exercises to interpret on the geologic history of two rather complex hypothetical areas. Relief models scaled to represent adjacent 15-minute quadrangles and fossils and rock samples "collected" from localities in the two areas provide the basis for determining age of beds and interpreting paleoecology. The program includes: construction of topographic maps, age determination of beds, structural interpretation, reconstruction of paleogeography and paleoecology, construction of geologic maps, and summary of geologic history.—GDC

01392 **Miller, Ralph L.; Hadley, Jarvis B.; Cox, Dennis P.** General geology, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 55–80, illus., tables, 1968.

An extremely cursory review of the general geology of Appalachia is given; no details are included. Precambrian to Quaternary rocks are described briefly. Generalized cross sections are included.—HRC

06959 **Miller, T. H.** Techniques for processing and photographing chitinozoans: Kansas Univ. Paleont. Contr.—Paper 21, 10 p., illus., 1967.

Chitinozoans and associated acid-insoluble forms (e.g., graptolite siculae, acritarchs, microscolecodonts, and problematica) have great potential for dating and zoning Ordovician-to-Devonian surface and subsurface sections. These microfossils occur in the heavier fraction of residues and may not appear in abundance on slides prepared by the usual spore-pollen processing techniques. Modified palynologic processing methods, however, facilitate their recovery. Special techniques, such as illumination by infrared light or a laser beam, are useful for examining and photographing thick and dark but incomplete carbonized chitinozoans and associated forms.—Author's abstract

06969 **Milligan, J. H.** Mineralized springs and their effect on Utah's water supplies, *in* Groundwater development in arid basins—Symposium, Utah State Univ., 1967, Proc.: Logan, Utah, Utah State Univ., p. 43–50, illus., 1967.

The major objectives of the investigation were to obtain an inventory of mineralized springs with their hydrologic and geologic setting and quantity and quality of water, to appraise their current and potential effects on important usable supplies, and to evaluate possible management and control measures. Most of the springs lie in the Great Basin drainage, are directly associated with the fault pattern, and bring to the surface dissolved salts from underlying marine beds. The effect of these springs on river quality is considered, and, since they represent ground-water outflow, may indicate contamination of ground water. They may also contaminate alluvial aquifers on their way to the surface.—ESL

Milligan, James H. *See* Williams, J. Stewart. 01486

Milligan, James H. *See* Clyde, Calvin G. 07016

01181 **Mills, H. G.** Geology of Tom O'Connor field, Refugio County, Texas [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 541–542, 1968.

Minard, James P. *See* Owens, James P. 01403

01623 **Misaqi, F. Leo.** (Fazlollah Missaghi). Geochemical anomalies in the Philmont Ranch region, New Mexico: New Mexico Bur. Mines and Mineral Resources Circ. 92, 12 p., illus., table, 1968.

Stream sediment samples taken at Philmont Scout Ranch and adjacent areas, were tested for arsenic, lead, zinc, molybdenum, and copper. Some locations in the south-central, southwestern, and southern parts of the investigated area were found anomalous in metal content of stream sediments. The economic significance of the anomalies is yet to be established.—Author's abstract

01582 **Mitterer, R. M.; Hoering, T. C.** Production of hydrocarbons from the organic matter in a Recent sediment: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 510–514, illus., table, 1968.

Heating a sediment in the laboratory and analyzing the products give clues to the types of organic reactions occurring under natural conditions. Soluble paraffinic hydrocarbons were recovered before heating a Recent marine sediment from the San Nicolas Basin off southern California, and a portion containing kerogen only was heated and the hydrocarbons separated. Their gas chromatographic retention times were similar to those of pristane and phytane, isoprenoid hydrocarbons diagnostic of life processes, and found in ancient sediments and petroleum. Porphyrins were also generated by heating the sediment. Probable precursors of normal hydrocarbons are normal alkyl chains and their release involves bond breakage and hydrogenolysis, implying the presence of a hydrogen donor. Results of experiments to explore the reducing power of sediments indicate that kerogen in Recent sediments is a major source of hydrocarbons.—ESL

01477 **Moberly, Ralph, Jr.** Loss of Hawaiian littoral sand: Jour. Sed. Petrology, v. 38, no. 1, p. 17–34, illus., 1968.

Losses or gains between individual beach and nearshore sand reservoirs in Hawaii are temporary (seasonal) or permanent. Permanent changes in littoral sand supply include loss by (1) wave and current transportation to deep water through sand-bottomed channels that cross reefs, (2) entrapment in aggrading deltas and other coastal features, (3) surf abrasion to silt size, (4) wind transportation inland, (5) cementation in beachrock, and (6) removal by man.—*from* Author's abstract

01456 **Modarresi, Hassan G.** Simple and effective device for gravity separation of heavy mineral grains: Jour. Sed. Petrology, v. 38, no. 1, p. 240–242, illus., 1968.

A special separatory device is described by which heavy minerals can be separated according to their specific gravities using Clerici solution in sequential dilutions. The device uses only small amounts of Clerici solution and is effective with small samples of heavy minerals.—HAT

Moh, G. *See* Kullerud, G. 01553

01478 **Moiola, R. J.; Weiser, D.** Textural parameters—An evaluation: Jour. Sed. Petrology, v. 38, no. 1, p. 45–53, illus., 1968.

Simple correlation graphs of some pairs of the textural parameters—mean diameter, standard deviation, skewness and kurtosis—of modern beach, coastal dune, inland dune and river sands may be used to differentiate between sands from the different environments of deposition. Mean diameter correlated with skewness graphically separates beach from inland dune, and inland dune from coastal dune sands. Mean diameter correlated with standard deviation separates beach from river sands and river sands from coastal dune sands. Satisfactory graphic separations could not be obtained between beach and coastal dune or between river and inland dune sands. Parameters tested were computed from quarter, half and whole phi percentile data obtained graphically. Parameters obtained from quarter phi data were most effective.—RAC

07036 **Montanari, John H.** Datos hidrológicos y de gastos de agua, República Dominicana: Washington, D.C., Organización de los Estados Americanos, scale 1:250,000, 1967.

Moore, Raymond C. *See* Beaver, Harold H. 07125

06972 **Moore, W. G.** A dictionary of geography—Definitions and explanations of terms used in physical geography: New York and Washington, Frederick A. Praeger, Publishers, 246 p., illus., revised and enlarged 1967; originally published 1949.

This third revision of the dictionary is extensively enlarged over past editions, 500 of the entries being either new or rewritten and expanded. There are 32 photographs, 10 of which are new, and 56 line drawings, many new.—ESL

01637 **Mooser, O.** Fossil Equidae from the middle Pliocene of the Central Plateau of Mexico: Southwestern Naturalist, v. 13, no. 1, p. 1–12, illus., tables, 1968.

In the past 12 years a large collection of fossil horse teeth have been assembled from a ravine, locally named La Carreta, near the village of El Ocote, Guanajuato, Mexico. The Ocote local fauna is of lower Hemphillian age, and is one of the most important Pliocene vertebrate faunas reported from Mexico. Fossils from Ocote are largely isolated teeth of horses, though some foot and limb bones were recovered and other kinds of mammals were found. The teeth are well-preserved but the bones are quite fragile. Such fragility possibly accounts for the large number of isolated teeth and for the scarcity of jaw fragments with cheek teeth in place. Three new species are described: *Astrohippus albidens*, *Nannippus aztecas*, and *N. hesperides*. Further information is provided for *Neohipparion otomii* Mooser.—*from* Author's abstract

01492 **Morehouse, David F.** Cave development via the sulfuric acid reaction: Natl. Speleol. Soc. Bull., v. 30, no. 1, p. 1–10, illus., tables, 1968.

Data from chemical analyses conducted on the waters of Level Crevice Cave, Dubuque, Iowa, support the hypothesis that the major solution reaction occurring in and around the cave, and therefore locally in the Galena dolomite, involves sulfuric acid, not carbonic acid. Explanations of anomalous features of the cave, especially the valley bar, are greatly simplified by the sulfuric acid reaction mechanism; the amount of acid produced varies directly with the amount of pyrite or marcasite traversed by the water, so that a deeper passage is larger than one close to the surface—the reverse of development by carbonic acid solution. It may be found that cave development by the sulfuric acid reaction is more common in other areas and in other bedrock than has been previously thought.—VMJ

01577 **Morimoto, N.; Güven, N.** Refinement of the crystal structure of pigeonite $(Mg_{0.39}Fe_{0.52}Ca_{0.09})SiO_3$: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 494–497, tables, 1968.

Purpose of the study is to refine the crystal structure of pigeonite with three dimensional data, and to elucidate the effect of Ca atoms in clinopyroxene structures. Effort was concentrated on: (1) distribution of divalent Ca, Fe, and Mg atoms among possible sites M1 and M2; (2) the nature of the coordination around the M1 and M2 sites; and (3) the reason for the diffusiveness of the $h+k=2n+1$ reflections which implies that the pigeonite has possibly a domain structure. Results based on 38 independent measurements are: $a=9.706\pm0.002$, $b=8.950\pm0.001$, $c=5.246\pm0.001$ A, and $\beta=108.59\pm0.01°$.—ESL

Mosher, Robert E. *See* Sanford, John T. 01194

Mountjoy, E. W. *See* Pray, L. C. 01185

Muan, Arnulf. *See* Nafziger, R. H. 07027

Muir, I. D. *See* Lindsley, D. H. 01539

Munoz, J. L. *See* Lindsley, D. H. 01541

01543 **Munoz, J. L.** Effect of shearing on enstatite polymorphism: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 369–370, 1968.

Experiments were performed in the shearing squeezer to investigate the effect of shearing stress on the temperature of the rhombic enstatite⇒clinoenstatite inversion. At all pressures (up to 20 kb), the results are in complete agreement with those of Riecker and Rooney (1966), who reported the formation of clinoenstatite from rhombic enstatite at temperatures as high as 1000°C under shearing stresses. The experiments have revealed an effect of shearing stress on the rate of the rhombic enstatite clinoenstatite reaction, but they are inconclusive in regard to clinoenstatite stability. Thus, the interpretation of the equilibrium boundary is still unclear.—MST

01544 **Munoz, J. L.** High-pressure stability relations of spodumene: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 370–374, illus., 1968.

In investigations of the high-pressure stability relations of spodumene, it is found that pressure drastically alters the phase relations of lithium aluminum silicates; notably, the low-pressure, high-temperature tetragonal polymorph (β-spodumene) is replaced at higher pressures by a hexagonal polymorph with a high-quartz structure.—MST

01648 **Murphy, Richard E.** Landforms of the world: Assoc. Am. Geographers Map Supp., no. 9, scale about 1 in. to 800 mi., 1968; also in Assoc. Am. Geographers Annals, v. 58, no. 1, 1968.

01463 **Mutch, Thomas A.; Head, James W., 3d; Saunders, R. S.** Photographic interpretation of Catskill Front stratigraphy, southeastern New York State: Jour. Sed. Petrology, v. 38, no. 1, p. 259–262, illus., 1968.

Infrared and high contrast panoramic photographs of Devonian nonmarine sedimentary rocks exposed along the Catskill Front, southeastern New York, reveal

details of sandstone body continuity. The laterally persistent Kaaterskill sandstones in the upper part of the sequence may mark a transition from meandering stream to braided stream deposition.—Authors' abstract

01182 **Myers, Donald A.** Stratigraphic distribution, Pennsylvanian fusulinids, Manzano Mountains, New Mexico [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 542, 1968.

07030 **Nadjmabadi, Siavash.** Paleo-environment of the Guilmette Limestone (Devonian) near Wendover, Utah: Brigham Young Univ. Geology Studies, v. 14, p. 131–142, illus., 1967.

The Guilmette Limestone (Devonian) is well exposed in the western part of the Leppy Range in Nevada, north of Wendover where a complete section comprising slightly more than 1,400 feet was studied in detail. A duplicate section, about one half mile to the south, was also measured and described. Light- to medium-gray, micritic to skeletal limestone comprises the lower part of the section; the middle part is typified by a thick- to medium-bedded, fine textured limestone which varies from skeletal to reef types; the upper part is characterized by interbedded micritic to skeletal limestone and dolomite. Warm, shallow, and quiet to slightly agitated water conditions seemingly predominated throughout Guilmette time, as evidenced by typical marine fossil assemblages of corals, stromatoporoids, pelecypods, brachiopods, gastropods, stromatolites, and algae.—*from* Author's abstract

07027 **Nafziger, R. H.; Muan, Arnulf.** Equilibrium phase compositions and thermodynamic properties of olivines and pyroxenes in the system MgO–"FeO"–SiO_2: Am. Mineralogist, v. 52, nos. 9–10, p. 1364–1385, illus., tables, 1967.

Compositions of coexisting spinel, olivine, and pyroxene, determined at low oxygen fugacities using gas mixtures, are used to derive activity-composition data for the solid-solutions and stability data for the end-member compounds. Olivine solid-solutions show moderate positive deviation from ideality, but the pyroxene-solid solution is practically ideal in its activity-composition relation. The results permit the checking and refining of assumptions concerning the distribution of Fe^{2+} and Mg^{2+} ions in minerals.—JSH

06978 **Nagata, Takesi; Ozima, Minoru.** Paleomagnetism, *in* Physics of geomagnetic phenomena, V. 1: New York and London, Academic Press (Internat. Geophysics Ser., V. 11–1), p. 103–180, illus., tables, 1967.

This chapter discusses the magnetic properties of minerals and processes of acquisition of remanent magnetization; a summary of paleomagnetic data for the direction and intensity of the geomagnetic field in ancient times, obtained only from stable samples; and theoretical interpretations of the main paleomagnetic results.—VSN

Naldrett, A. J. *See* Craig, J. R. 01555

01556 **Naldrett, A. J.** Melting relations over a portion of the Fe–S–O system and their bearing on the temperature of crystallization of natural sulfide-oxide liquids: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 419–427, illus., 1968.

In the present report, data on liquidus and solidus relations have been extended to compositions falling on the join between magnetite and a pyrrhotite solid solution containing 60 wt percent iron, and, therefore, covering the compositions of many typical ore magmas. Data are shown in a series of diagrams.—MST

01557 **Naldrett, A. J.; Brown, G. M.** Reaction between pyrrhotite and enstatite ferrosilite solid solutions: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 427–429, illus., 1968.

Experiments to study equilibria between pyrrhotite and enstatite-ferrosilite solid solutions at high temperatures in the presence of vapor, excess quartz, and magnetite are described. Comparison between limits set in these experiments and the composition of sulfides and iron-bearing silicates in ore deposits may indicate

whether sulfides were introduced with the magma or after the host rocks crystallized.—ESL

01558 **Naldrett, A. J.; Richardson, S. W.** Effect of water on the melting of pyrrhotite–magnetite assemblages: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 429–431, illus., 1968.

Mineralogy and field relations of some sulfide–oxide ore deposits require them to have been introduced at temperatures well below the solidus temperatures obtained in experiments. Since water is a possible flux for sulfide melts, this study was done to test the extent of water solubility in magnetite–pyrrhotite liquids by determining the solidus temperature at 2 kb fluid pressure. It is concluded that water has little effect on melting temperatures.—ESL

Naldrett, A. J. *See* Craig, J. R. 01559

01561 **Naldrett, A. J.; Craig, J. R.** The Fe–Ni–S system—[Pt. 2] Partial pressure of sulfur in the vapor coexisting with the $Fe_{1-x}S$–$Ni_{1-x}S$ solid solution at 600° and 400°C: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 436–440, illus., 1968.

The partial pressure of sulfur is one of the most important variables to be considered in determining the chemical conditions under which ore deposits form. Compositions of many iron–nickel sulfide deposits fall within the limits of the solid solution studied. Techniques used in the studies are described and diagrams are given illustrating a portion of the system with isopleths showing the partial pressure of sulfur in the vapor coexisting with the Mss at 600° and 400°C.—ESL

Naldrett, A. J. *See* Craig, J. R. 01562

07095 **Neathery, Thornton L.** Economic geology of the Alabama Carboniferous, *in* A field guide to Carboniferous detrital rocks in northern Alabama—Geol. Soc. America, Coal Div., 1967 Field Trip: University, Ala., Alabama Geol. Soc., p. 34–101, illus., tables, 1967.

Coal is undoubtedly the greatest mineral resource of the area; almost 15 million tons were mined in 1965. The occurrence of coal in each of the coal fields is described cursorily. The Mississippian limestones have been used extensively for road metal, flux, lime, riprap, and building stone; a general description of their occurrence is given. Clay, shale, sand, and gravel are present also. Rock-asphalt deposits are known to occur in some of the Mississippian rocks, and two natural gas fields are present in Marion County. No details of any of the deposits are given.—HRC

Neathery, Thornton L. *See* Ferm, John C. 07097

06993 **Nesteroff, Wladimir D.** Quelques résultats sédimentologiques des premiers forages du précontinent américain (JOIDES): Soc. Géol. France Bull. 1966, 7th ser., v. 8, no. 6, p. 773–785, illus., tables, 1967.

On the continental margin off Florida, all six JOIDES boreholes reached Eocene, and two Paleocene formations; all thicken outward. On the shelf early deposits were calcareous oozes and shelly sands; the Miocene grades upward from lagoonal phosphatic muds to open-sea silts. On the slope alternate beds of Eocene and Oligocene limestone and calcareous mudstone indicate turbidity currents, the Miocene is absent, and the post-Miocene grades upward from foraminiferal mud to half-terrigenous and half-bioclastic sands. On the deeper Blake Plateau terrigenous Paleocene clays gave way, in part of the Eocene, to globigerinal oozes and volcanic ash. Today as in early Eocene, complex currents sweep this plateau, altering the percentages of $CaCO_3$. Important gaps in the sedimentary column verify discontinuity between it and the continental shelf; the connecting slope shows both pelagic and turbidite deposition.—GDC

07084 **Neuman, Robert W.** Radiocarbon-dated archaeological remains on the northern and central Great Plains: Am. Antiquity, v. 32, no. 4, p. 471–486, illus., table, 1967.

This paper consolidates and summarizes the mass of radiocarbon determinations in publications and manuscripts between 1951 and the spring of 1965. The dates are derived from Paleo-Indian, Archaic, Early Ceramic, and Late Prehistoric occupations in the Canadian provinces of Alberta and Saskatchewan and the Plains areas of Montana, Wyoming, Colorado, North Dakota, South Dakota, Nebraska, Kansas, and Iowa. Included are 195 radiocarbon dates attesting to the presence of man on the Plains for the past 12,000 years.—*from* Author's abstract

01401 **New York State Geological Assoc.; Finks, Robert M.** (editor). Guidebook to field excursions at the 40th Annual Meeting, Queens College, Flushing, N. Y., May 1968: Brockport, N. Y., State Univ. Coll., Dept. Geology, 253 p., illus., tables, geol. map, 1968.

The guidebook contains road logs and maps for ten field trips, each by a different leader and cited separately. The trips are designed to study the following general concepts: the relation of the New York City Group to the unmetamorphosed Cambro-Ordovician sequence, the several phases of Taconian deformation, the nature of the pre-Triassic basin in the Newark Basin area, and comparison of deltaic sedimentation in the Devonian, the Cretaceous, and the Pleistocene.—HRC

01491 **Newcome, Roy, Jr.; Shattles, D. E.; Humphreys, C. P., Jr.** Water for the growing needs of Harrison County, Mississippi: U.S. Geol. Survey Water-Supply Paper 1856, 106 p., illus., tables, 1968.

The potential for water-supply development in Harrison County is almost unlimited; during an average year more than 350 billion gallons of water flow into the Gulf of Mexico from the county's streams. The ground-water reservoir, presently providing all fresh-water supplies, is capable of supporting many times the 25 million gpd withdrawal from Pliocene and Miocene sand aquifers at depths as great as 2,500 feet. Many aquifers have high transmissibility (50,000-100,000 gpd per ft), and although few wells produce more than 1,000 gpm, several aquifers can yield two to three times that amount. Artesian water levels along the coast are declining at a rate of 1 ft per yr on the average; however, water levels are still above or only slightly below land surface in most places. Nearly all ground water is of good quality and requires little or no treatment for most uses.—*from* Authors' abstract

01326 **Newman, William L.; Stansfield, Robert G.; Eilertsen, Nils A.** Dimension stone, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 191-206, illus., tables, 1968.

A cursory description of the types and occurrences of building stones of various sorts in Appalachia is given; no new details are included. Marble and limestone occur extensively in Tennessee, Georgia, and Alabama; sandstone is abundant throughout the area; and granite is very prevalent in the Piedmont regions. Slate and a few miscellaneous types of rocks are also discussed briefly.—HRC

07106 **Nicholls, G. D.** Geochemical studies in the ocean as evidence for the composition of the mantle, *in* Mantles of the Earth and terrestrial planets (S. K. Runcorn, editor): London and New York, Interscience Publishers, p. 285-304, tables, 1967.

Chemical composition of the upper mantle under oceanic areas is a combination of the volatile, basaltic lava, and residual fractions. Surface expressions of this composition are found in basalt lava and volcanic gases. Limits of the possible compositions of these fractions are defined, omitting all materials that were erupted through or contaminated by continental crust. It is likely that variations in chemical composition in the upper mantle occur within the ranges defined.—JPF

01600 **Northcutt, Fred.** A 3-D model of the earth's magnetic field: Jour. Geol. Education, v. 16, no. 2, p. 47-49, illus., 1968.

The Earth's magnetic field and its properties, phenomena associated with the internal features of our Earth, are an integral part of studies in geology and earth science. For many students earth magnetism is an "attractive" yet mysterious facet of their study. It has always been a problem to provide students with an accurate and realistic model of the Earth's magnetic field. This article describes the construction

of a model that students may use to investigate a three-dimensional geomagnetic field and its associated properties.—Author's abstract

Nuti, S. *See* Longinelli, A. 01506

01603 **Ocean Industry.** Ocean-bottom minerals: Ocean Industry, v. 3, no. 6, p. 61-73, illus., tables, 1968.

Marine beach deposits, formed when the sea level was lower probably will be the primary target of continental shelf mapping and of contracts for heavy mineral surveys. Heavy mineral sources in modern submerged beaches are described for each mineral, including sand, gravel, and diamonds. Phosphorite occurs as coatings, or as oolites, flat slabs, or irregular masses; its origin may be organic or related to upwelling. It can probably be found off any coast having a continental shelf during the Tertiary, with oceanic conditions similar to those off California, where 1.5 billion tons are estimated to have formed. Glauconite sand also occurs off California and Oregon. Coal has been mined off the coasts of several countries, and barite concretions dredged. The origin of manganese nodules is uncertain; they have been reported from widely scattered places, and the Pacific alone is estimated to have 1 1/2 trillion tons.—ESL

01351 **O'Connor, Michael Peter.** Stratigraphy and petrology across the Precambrian Piegan Group-Missoula Group boundary, southern Mission and Swan Ranges, Montana [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 8, p. 3342B, 1968.

06997 **Oeschger, H.; Langway, C. C., Jr.; Alder, B.** An in situ gas extraction system for radiocarbon dating glacier ice: U.S. Army Materiel Command Cold Regions Research and Eng. Lab. Research Rept. 236, 4 p., illus., table, 1967.

In March 1966 at the Tuto ice tunnel, Greenland, a team from USA CRREL and the University of Bern tested a new down-borehole device which would allow gas to be extracted from within shallow or deep boreholes. The tunnel ice was unfractured and its temperature was constant at -10° C. A location where, in 1964, C-14 age dates had been obtained was used as a check point for the down-borehole tests. Comparative samples show good agreement and indicate a mean value of 5,120 years B.P. for the age of ice at this location. The simplicity of the down-borehole gas extraction system enables application of the carbon dating method to any natural, undisturbed glacier ice mass which can be sampled by boring. The gas extraction apparatus and field experiments are described.—Authors' abstract

01332 **Ohio Geological Society; Geological Society of Kentucky.** Geological aspects of the Maysville-Portsmouth region, southern Ohio and northeastern Kentucky—Joint Field Conf., May 1968: [Lexington, Ky.] Kentucky Geol. Survey, 86 p., illus., 1968.

In this guidebook, the first day's itinerary presents the stratigraphy (Upper Ordovician to Pennsylvanian) of Scioto and Adams Counties, Ohio, with critical examination of important outcrops at eight stops, as well as observations in transit. Detailed discussion of the stops by leaders (Calvert et al) and also the appended section on surface and subsurface stratigraphy compiled by Calvert are cited separately. The second day's trip crosses a 40-mile outcrop of Ordovician-Mississippian formations in northeastern Kentucky, with emphasis on stratigraphic relationships of the Silurian, Devonian, and Mississippian strata. Comparison of Kentucky and Ohio exposures, facies gradations and intertonguing, and cyclic sedimentation are of special interest. Discussion of these stops, by Peck and Weir, is cited separately.—GDC

01419 **Oliver, Howard W.; Mattick, Robert E.** Geophysical investigations of the channel gravel, *in* Tertiary gold-bearing channel gravel in northern Nevada County, California: U.S. Geol. Survey Circ. 566, p. 11-22, illus., 1968.

Several methods have been tested for determining configuration of buried bedrock surface, delineating channel gravel under volcanic rocks, and identifying concentrations of heavy minerals. A combination of seismic-refraction and gravity determined depth and configuration of channel bottom to an accuracy of 10 percent as checked by drill holes. Seismic-refraction has identified depressions in bedrock

surface below volcanic rocks, and possibly occupied by gravels; seismic methods cannot recognize low-velocity gravels beneath higher velocity volcanic rocks. Electromagnetic methods supplemented by induced-polarization show promise of recognizing and tracing blue gravel buried less than 200 feet. A broad vague magnetic anomaly suggests more precise studies might delineate concentrations of magnetic material. Resistivity methods are restricted due to irregular topography and variable conductivity of layers.—*from* Authors' abstract

07117 **Olsen, Edward.** A new occurrence of roedderite and its bearing on osumilite-type minerals: Am. Mineralogist, v. 52, nos. 9–10, p. 1519–1523, tables, 1967.

Electron microprobe analysis confirmed the occurrence of roedderite as inclusions within graphite nodules in the octahedrite iron meteorite, *Wichita County* (U.S.A.). Associated nonopaque minerals include olivine, plagioclase, richterite, and a new Na–Mg–Cr silicate. Optical properties are: $\alpha = 1.536 \pm 0.002$, $\beta = 1.536$ $\gamma = 1.543 \pm 0.002$, $+2V = 5°–8°$ (est.); dichroism was not observed. X-ray powder diffraction data are compared to osumilite, roedderite from the Indarch meteorite, and synthetic $K_2O{:}5MgO{:}12SiO_2$ and $Na_2{:}5MgO{:}12SiO_2$, all of whose patterns are strikingly similar.—MEM

07066 **Olsen, S. J.** A note in regard to osteological field manuals: Am. Antiquity, v. 32, no. 2, p. 231, 1967.

This article calls attention to the lack of cooperation among osteologists in sharing with archaeologists their information concerning bone identification by way of field manuals.—Author's abstract

01471 **Onions, Diane; Middleton, Gerard V.** Dimensional grain orientation of Ordovician turbidite graywackes: Jour. Sed. Petrology, v. 38, no. 1, p. 164–174, illus., tables, 1968.

The orientations of quartz grains in 44 beds of the Normanskill Formation of the Hudson Valley of New York deviate significantly from the orientations of sole markings of the beds. The grains in each of 85 percent of the beds show a preferred orientation at the 90 percent significance level. Eighty percent of measured imbrications have an upstream orientation. Deviations of grain orientation from sole markings show no relationship to height above base of the beds. Maximum grain size decreases and maximum elongation increases in relation to height above base of the beds.—RAC

Opdyke, Neil. *See* Ku, Teh-Lung. 01606

01403 **Owens, James P.; Minard, James P.; Sohl, Norman F.** Crétaceous deltas in the northern New Jersey Coastal Plain, Trip B *in* Guidebook to field excursions—New York State Geol. Assoc., 40th Ann. Mtg., Flushing, N. Y., 1968: Brockport, N. Y., State Univ. Coll., Dept. Geology, p. 33–48, illus., 1968.

A discussion of general characteristics of marine deltas is followed by a description of the units exposed in the Cretaceous deltas of New Jersey. A road log for a trip of 31 miles with six stops is given. The trip is concerned primarily with the Raritan, Magothy, and Merchantville Formations, in which deltaic characters are displayed.—HRC

Oxley, Susanna A. *See* Gordon, Glen E. 01513

Ozima, Minoru. *See* Nagata, Takesi. 06978

06965 **Padgham, W. A.** The geology of the Guncoat Bay area, Saskatchewan: Saskatchewan Dept. Mineral Resources Rept. 78, 143 p., illus., table, geol. maps, 1966 [1967].

The map-area, on the Churchill River Plain, contains innumerable lakes and muskegs; glacial debris is widely distributed. Consolidated rocks are Precambrian, mostly regionally metamorphosed supracrustal, upper amphibolite facies, and locally lower granulite. A second group was derived from supracrustal rocks by movement

of chemical components. A third group, syntectonic granites, forms intrusive lenticular masses; a fourth group crosscuts all older structural elements. Age relations between groups are well established, but are unknown within them. The area is on the west side of the Planishek Lake structural basin, and its structure is extremely complex; the tectonic history is summarized and mesoscopic structures and macroscopic geometry are analyzed. Geologic maps include Lac La Ronge region, Stauffer Lake folds, and Otter Lake antiform, as well as the map-area. Cross sections accompany the latter.—ESL

01436 **Paine, William R.; Meyerhoff, A. A.** Catahoula Formation of western Louisiana and thin-section criteria for fluviatile depositional environment: Jour. Sed. Petrology, v. 38, no. 1, p. 92–113, illus., tables, 1968.

The formation, of late Oligocene(?)–early Miocene(?) age, is a fluviatile–lacustrine unit which at depth contains hydrocarbons. Criteria recognized in thin section which identify the formation as fluviatile nonmarine are: textural immaturity, poorly sorted quartz grains, bimodal particle-size distributions, low grain roundness and sphericity, moderately abundant flat-grain alignments, absence of unabraided marine fossils, presence of wood, leaves, bone fragments and fresh-water mollusks, scarcity of glauconite, absence of authigenic primary and secondary cements or grains of calcite, dolomite, or siderite. Volcanic detritus is the major component of the formation. Quartz, chert, and heavy minerals derived from metamorphic, plutonic and sedimentary terranes form the remainder. Data on feldspars, matrices and diagenesis are incomplete.—RAC

Palmer, K. R. *See* Dawson-Grove, G. E. 01628

01449 **Pangborn, Mark W., Jr.** (compiler). Buying list of geology books for high school libraries: Jour. Geol. Education, v. 16, no. 2, p. 65–68, revised 1968; originally published 1967.

The books and other materials in this list are suitable for high school students, grades 9 through 12. A number of college textbooks have been included to whet the appetite of the serious student. Titles marked with an asterisk are recommended for first purchase.—Author's abstract

01631 **Papadopulos, I. S.; Aten, R. E.** Investigation program for aquifer protection requirements, Chicagoland Deep Tunnel Plan: Ground Water, v. 6, no. 3, p. 4–9, illus., 1968.

The plan envisions temporary storage of combined sewer overflows in tunnels excavated in solid rock, deep under the City. Later, stored water would be pumped to the surface and treated before being discharged into waterways. Planning studies indicate the most favorable location for tunnels is the Galena–Platteville Dolomite, uppermost member of the Cambrian–Ordovician aquifer. Protection of this highly-developed aquifer from contamination is therefore mandatory. An electric analog model indicates that aquifer protection can be provided by a system of recharge wells maintaining flow into the tunnels at all times. Further studies include: detailed exploratory drilling, controlled aquifer tests in selected zones, pumping tests for specific capacity in the zone to be tunneled; recharge injection tests; and analog model analysis for future effects of tunnels and recharge operations.—*from* Authors' abstract

07048 **Papadopulos, Istavros S.** Nonsteady flow to a well in an infinite anisotropic aquifer [with French abs.], *in* Hydrology of fractured rocks—Dubrovnik Symposium, 1965, Proc., V. 1: Internat. Assoc. Sci. Hydrology Pub. 73, p. 21–31, illus., table, 1967.

Well flow equations presently used in analysis of pumping tests and prediction of water levels have been derived under the assumption that aquifers are isotropic; they are not applicable to anisotropic aquifers such as fractured rocks. An equation is derived for drawdown distribution around a well discharging at a constant rate from an infinite anisotropic aquifer; drawdowns computed are compared and found to be in good agreement with those observed in an electric-analog model constructed for this purpose. Pumping test data from a minimum of three observation wells

can be analyzed to obtain components of the transmissibility tensor along an arbitrarily chosen set of axes, and the components, in turn, can be used to determine principal transmissibilities and orientation of the principal axes. The method is illustrated with an example.—*from* Author's abstract

01472 **Park, Won C.; Schot, Erik H.** Stylolites—Their nature and origin: Jour. Sed. Petrology, v. 38, no. 1, p. 175–191, illus., table, 1968.

Stylolites are defined on the basis of grain fabrics and classified on their geometry and their relationship to the bedding plane. Microscopic study of stylolites from several units from different localities shows the following features to occur near or within the stylolitic seams: concentration of insoluble residues, dissolution, recrystallization, grain growth, grain orientation, pressure twinning, pressure shadows, microfaulting and shearing, cavity filling, and geopetal features. Most stylolites are herein interpreted to be diagenetic features initiated during the early burial stage and ending upon the complete elimination of pore space by drusy mosaic carbonate. Tectonically produced stylolites are considered to be the result of pressure solution and recrystallization due to physical factors rather than to chemical factors.—HEC

01382 **Parker, Raymond L.; Hobbs, Robert G.** Niobium (columbium) and tantalum, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 425–426, illus., 1968.

These two rare elements are found in Appalachia only in pegmatites in the Spruce Pine District of North Carolina, and then not in commercial quantities. A very brief description of their occurrence is given.—HRC

01352 **Patenaude, Robert William.** A regional aeromagnetic survey of Wisconsin [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 8, p. 3342B–3343B, 1968.

Paterson, Norman R. *See* Swift, Donald J. P. 01417

Patterson, B. *See* Butler, P. M. 07055

01375 **Patterson, Sam H.; Sweeney, John W.** Aluminum—metal and raw materials, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 364–372, illus., tables, 1968.

A brief description of the occurrence of aluminum-bearing rocks, primarily bauxite, in Appalachia is given; no new data are included, however. Bauxite comes primarily from Georgia and Alabama, with a small amount from Tennessee.—HRC

Patterson, Sam H. *See* Hosterman, John W. 01393

07090 **Patton, Thomas H.** Oligocene and Miocene vertebrates from central Florida, *in* Miocene and Pliocene problems of peninsula Florida—Southeastern Geol. Soc., 13th Field Trip 1967 [guidebook]: Tallahassee, Fla., Southeastern Geol. Soc., p. 3–11, 1967.

Vertebrates in an Oligocene fauna discovered in a sinkhole near Gainesville are listed. The only early Miocene fauna of importance is found at the Brooksville site, the most important middle Miocene vertebrate locality in eastern North America is Thomas Farm in Gilchrist County (forms included are listed), and the nearest localities for late Miocene are in northern Florida and southern Georgia. One of the most important aspects of recent discoveries is the revelation of a large and varied terrestrial fauna and its paleogeographic implications. Many forms formerly thought to be restricted to western faunas are now recognized, and help to date structural events.—ESL

01629 **Paul, A. H.** Some thoughts on climato-genetic regionalism in geomorphology: Albertan Geographer, no. 4, p. 31–37, illus., table, 1968.

The essential assumption behind use of climatic regions as geomorphic units is that under one climate the land-shaping processes act in the same fashion and on the

same scale, and their relative importance to each other is roughly constant. A parallel between climate-genetic landform regions and zonal soil classification is emphasized. Process study and the climatic approach to geomorphic regionalism are discussed. A classic article by Peltier (1950) included a nomogram for placing a station in its morphogenetic region by mean annual temperature and precipitation, accompanied by a modified list of processes operative in each morphogenetic region. It is suggested that this nomogram be adjusted for monthly climatic data; this is applied to Australia.—ESL

Paul, C. R. C. *See* Jefferies, R. P. S. 07058

Payson, H., Jr. *See* Mencher, Ely. 01435

01335 **Peck, John H.; Weir, Gordon W.** (leaders). Stops 1–6 [Kentucky], itinerary, Saturday, May 18, 1968, *in* Geological aspects of the Maysville–Portsmouth region, southern Ohio and northeastern Kentucky—Ohio Geol. Soc.–Geol. Soc. Kentucky, Joint Field Conf. 1968: [Lexington, Ky.] Kentucky Geol. Survey, p. 46–62, illus., 1968.

The Tollesboro section along the Kentucky side of the Ohio River exposes the Ordovician–Silurian contact and lithology of the lower Silurian sequence for which a graphic section is given. At Herron Hill the massive Bisher dolomite, overlain by the Ohio Shale and underlain by the Crab Orchard Formation, contains a bouldery "breccia" unit interpreted as an Upper Devonian solution collapse. Devonian and Mississippian exposures across the highway from Walnut Grove Church and on Apple Tree Hill represent lithology of the Ohio Shale to Borden Formation units, for which generalized geologic maps and a fence diagram are presented; in the Garrison quarry about 80 feet of Berea Sandstone is exposed with prominent flow rolls in the upper part, overlain by 16 feet of black Sunbury Shale and underlain by the Ohio Shale.—GDC

01685 **Pedersen, K. Raunsgaard; Lam, Jörgen.** Precambrian organic compounds from the Ketilidian of South-West Greenland, Pt. 1: Medd. om Grönland, v. 185, no. 5, 16 p., illus., 1968.

In the Ivigtut region, well preserved Ketilidian sedimentary rocks, about 2 b.y. old, contained macroscopic and microscopic fossils. Results on extractions of organic materials from a coal-graphite layer are presented together with a short description of local geology in the Graenseland area. Straight chain and branched paraffins, mono-, di-, or polycyclic aromatic hydrocarbons, borneol, camphor and other monoterpenoid compounds, fatty acids, and methyl esters of fatty acids were identified. Pristane, phytane and other isoprenoid hydrocarbons have been found in small amounts. A biological origin of the meter-thick coal-graphite layer is indicated. Further work on other sediments (dolomites and quartzites) from the succession is in progress.—GDC

01422 **Pelletier, B. R.** Sedimentation in arctic waters of the western Queen Elizabeth Islands, District of Franklin, Canada: Maritime Sediments, v. 3, no. 4, p. 90–99, illus., tables, 1967 [1968].

This report is a preliminary statement of continuing studies carried out since 1960 in Canadian Arctic waters under the direction of the Polar Continental Shelf Project. The program includes investigations in the following sedimentary environments: lacustrine, fluvial, inshore deltaic, inshore nondeltaic, channel, and offshore marine. Generally the mechanical properties of sediments vary with distance of sedimentary transport which is demonstrated from analyses of river and deltaic sediments. Offshore the variation is related to topographic features and the existence of ocean currents. Diagenesis has very little effect on sediments as shown by the dispersal pattern of the clay minerals and a comparison of the variation of the major metallic oxides from river and deltaic sediments.—*from* Author's introduction

01613 **Pemberton, H. Earl.** The minerals of the Sterling Borax Mine, Los Angeles County, California: Mineral Explorer, v. 3, no. 1, p. 1–10, illus., 1968.

The borate deposit in Tick Canyon, Los Angeles County, has been known, examined, and reported on for more than 60 years. This paper brings together the history of the mining operation, the geologic setting of the deposit, theories as to its origin, description of the mineral occurrences, and a selected bibliography. Colemanite has been the chief source of borax; the dispute about its origin is presented as summarized by Foshag (1921); his conclusions were endorsed by Murdoch and Webb (1954). Descriptions, briefly reviewed, include other borates; associated mineral occurrences and others in the adjacent area are mentioned.—GDC

Perry, Douglas. *See* Bubb, J. N. 01459

01482 **Perry, Kenneth, Jr.** A computer program for representation of mineral chemical analyses in terms of end member molecules: Wyoming Univ. Contr. Geology, v. 7, no. 1, p. 7–14, tables, 1968.

This program is designed to compute a given mineral chemical analysis in terms of a specific collection of molecular members or molecular end members. The method employed is quite general and may be extended to a mineral chemical analysis composed of any number of oxides. The program as written, however, is limited to those analyses composed of at most seven oxides. The program is written in Fortran IV language for the Philco 2000 computer.—Author's introduction

07013 **Perry, Kenneth, Jr.** A computer program which computes modal and mineralogic compositions within a ternary system: Wyoming Univ. Contr. Geology, v. 6, no. 2, p. 101–118, illus., 1967.

This program is designed to compute the mode and the chemical composition of each of the coexisting mineral phases in the modal assemblage within a ternary system at constant temperature and pressure. The program is written specifically with reference to the system SiO_2–FeO–MgO at 1 atm. and 1150° C. It is easily modified, however, to compute within the chemical composition spaces of this system at other temperatures. In addition, by substituting appropriate mathematical expressions for the mode and composition of individual mineral phases, the program can be modified to represent any ternary system. The program is written in Fortran IV language for the Philco 2000 computer.—Author's introduction

Peterson, David West. *See* Schwering, Felix K. 01679

01420 **Peterson, Donald W.; Yeend, Warren E.** Geology of the channel gravel, *in* Tertiary gold-bearing channel gravel in northern Nevada County, California: U.S. Geol. Survey Circ. 566, p. 1–11, illus., 1968.

Deposits of a huge Tertiary gravel-filled channel in northern Nevada County were the site of some of the most productive hydraulic gold mines in California from 1850–84. The gravel, partly covered by remains of an extensive volcanic rock sheet, crops out along the broad crest of the ridge between canyons of the South and Middle Yuba Rivers. Lower parts of the gravel deposits generally carry the highest value of placer gold; traditionally, richest deposits are found in so-called blue gravel, which contains appreciable quantities of secondary sulfide minerals, chiefly pyrite. Information in drill logs indicates a 2-mi stretch of channel near North Columbia contains over half a million ounces of gold dispersed through about 22 million cubic yards of gravel at a grade averaging about 81 cents per cubic yard. The deposit is buried at depths ranging from 100–400 feet.—*from* Authors' abstract

01183 **Peterson, James A.; Hite, Robert.** Pennsylvanian evaporite cycles and petroleum production, southern Rocky Mountains [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 544, 1968.

Philbin, P. W. *See* Popenoe, Peter. 01426

Philbin, P. W. *See* Popenoe, Peter. 01427

Phinney, R. A. *See* Anderson, D. L. 07010

01184 **Picard, M. Dane; High, Lee R., Jr.** Shallow-marine currents on Early(?) Triassic Wyoming shelf [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 544-545, 1968.

Picard, M. Dane. *See* High, Lee R., Jr. 01333

Pincus, H. J. *See* Gardner, R. D. 01620

Pirkle, E. C. *See* Brooks, H. K. 07088

Ponnamperuma, Cyril. *See* Schwartz, Alan. 01634

Ponnamperuma, Cyril. *See* Rabinowitz, Joseph. 01635

01426 **Popenoe, Peter; Philbin, P. W.; Gilbert, F. P.** Aeromagnetic map of the Worcester South quadrangle, Worcester County, Massachusetts: U.S. Geol. Survey Geophys. Inv. Map GP-623, scale 1:24,000, 1968.

01427 **Popenoe, Peter; Philbin, P. W.; Gilbert, F. P.** Aeromagnetic map of the Leicester quadrangle, Worcester County, Massachusetts: U.S. Geol. Survey Geophys. Inv. Map GP-624, scale 1:24,000, 1968.

Porter, J. W. *See* Fuller, J. G. C. M. 01224

Potter, Paul Edwin. *See* Hrabar, Stephanie V. 01220

01512 **Powell, H. E.; Ballard, L. N.** Magnetic susceptibility of copper-, lead-, and zinc-bearing minerals: U.S. Bur. Mines Inf. Circ. 8383, 11 p., illus., tables, 1968.

This is the fourth in a series of reports on the magnetic properties of minerals. The source, associated minerals, and magnetic susceptibility of 44 copper-, 26 lead-, and 19 zinc-bearing minerals are tabulated. The minerals include those commercially important and others of possible future significance.—VPB

01185 **Pray, L. C.; Cook, H. E.; Mountjoy, E. W.; McDaniel, P. N.** Allochthonous carbonate debris flows at Devonian bank ("reef") margins, Alberta [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 545-546, 1968.

Prescott, Ronald. *See* Bristol, H. M. 01520

Presley, B. J. *See* Brooks, R. R. 01594

01588 **Presnall, D. C.** P-V-T measurements on hydrogen up to 600°C and 1800 atmospheres: Carnegie Inst. Washington Yearbook 66, 1966-67, p. 539-541, illus., 1968.

It is concluded that the present data on hydrogen, together with fugacity values of Holser (1954) for water and the assumption of ideal mixing, provide a basis for calculating oxygen fugacities in H_2-H_2O mixtures that is sufficiently accurate for most purposes. For oxygen fugacities higher than those for the magnetite-wüstite buffer, the apparatus described by Shaw (1963) can be used with negligible error in the calculated oxygen fugacity.—Author's conclusions

01186 **Pryor, Wayne A.** Permeability-porosity patterns of some Recent sediments [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 546, 1968.

01187 **Pryor, Wayne A.; Barr, Jim L.** Sole marks in siltstone of nonturbidite origin [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 546, 1968.

01188 **Pryor, Wayne A.; Hester, Norman C.** X-ray diffraction analysis of heavy minerals [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 546, 1968.

01663 **Pryslak, A. P.** MacNicol township, District of Kenora: Ontario Dept. Mines Prelim. Geol. Map P. 471, scale 1 in. to 1/4 mi., text, 1968.

The metavolcanic–metasedimentary sequence of rocks in MacNicol township is mainly intermediate to mafic tuffs, agglomerates and flows, with lesser amounts of arkoses and greywackes; grade of metamorphism ranges from upper greenschist to almandine amphibolite facies. Pegmatite, pegmatitic granite, and aplite intrude the sequence. The dominant structural feature is foliation which conforms with the primary layering. No major faults were recognized, although minor shears were observed at numerous places. The area has been prospected extensively for uranium mineralization associated with pegmatite intrusions; uraninite and monazite have been identified as the radioactive minerals.—MCM

01664 **Pryslak, A. P.** Tustin township, District of Kenora: Ontario Dept. Mines Prelim. Geol. Map P. 472, scale 1 in. to 1/4 mi., text, 1968.

The metavolcanic–metasedimentary sequence of rocks in Tustin township consists mainly of intermediate to mafic tuffs, agglomerates, flows and minor amounts of greywacke and arkoses; grade of metamorphism ranges from upper greenschist to almandine amphibolite facies. Sills, dikes, and irregular bodies of metadiorite, metagabbro, metaperidotite, and metapyroxenite intrude the sequence. The dominant structural feature is foliation which conforms with primary layering; no major faults were recognized, although minor shears were observed at numerous places. Several massive sulfide zones 30–60 feet wide and up to 130 feet long occur in two locations and a series of lenticular sulfide zones occurs north of Medicine Lake. Uranium prospecting in the pegmatite intrusions has been extensive.—MCM

01595 **Purnell, Louis R.** Catalog of the type specimens of invertebrate fossils—Pt. 1, Paleozoic Cephalopoda: U.S. Natl. Mus. Bull. 262, 198 p., table, 1968.

This catalog is the first in a proposed series listing type specimens of the Division of Invertebrate Paleontology of the Smithsonian Institution. The only other catalog (Schubert, 1905, U.S.N.M. Bull. 53, pt. 1) covered the entire collection held at that time; since then the type collections have grown from about 11,500 to nearly 200,000 specimens. In compiling the cephalopod catalog all illustrated types were compared with published pictures, and all nomenclature was rechecked. All Paleozoic cephalopod type specimens acquired through 1965 are listed; the catalog is divided into four chapters: Nautiloidea, Ammonoidea, Bactritoidea, and Coleoidea. A full bibliography is included at the end.—GDC

01460 **Quakernaat, Joost; Gastner, Manfred.** A sample changer for oriented clay aggregates in X-ray diffraction: Jour. Sed. Petrology, v. 38, no. 1, p. 250–252, illus., 1968.

A simple, reliable, automatic sample changer was designed for routine qualitative diffraction analysis. It has a maximum loading capacity of eight oriented clay aggregates.—Authors' abstract

01635 **Rabinowitz, Joseph; Chang, Sherwood; Ponnamperuma, Cyril.** Phosphorylation on the primitive Earth: Nature, v. 218, no. 5140, p. 442–443, tables, 1968.

It is shown that conditions can be created in which inorganic phosphates act as phosphorylating agents. Such reactions may have occurred in prebiotic chemical processes.—DBV

01683 **Rahn, Perry H.** The hydrogeology of an induced streambed infiltration area: Ground Water, v. 6, no. 3, p. 21–32, illus., tables, 1968.

The University of Connecticut well field is located in a sand and gravel ice-contact stratified drift aquifer filling the Fenton River valley to a depth of about 60 feet. The water consists of captured ground-water underflow, normally discharging into the river, and water induced directly into the aquifer from the river flow by pumping. Measurements of streamflow made at three points in the river near two of these pumped wells show their influence. About 34 percent of the water pumped was stolen from the river via induced streambed infiltration. Water-level measurements in 30 observation wells installed around the pumped wells show cones of depression spreading underneath the river, following partially buried eskers. Because the vertical permeability of the streambed is less than the horizontal permeability of

the rest of the aquifer, the streambed is unable to recharge the aquifer with as much water as it can carry away.—*from* Author's abstract

Ramsbottom, W. H. C. *See* Jefferies, R. P. S. 07058

Randle, Keith. *See* Gordon, Glen E. 01513

Rasmussen, N. H. *See* Bostrom, R. C. 01522

Reay, A. *See* Harris, P. G. 07144

07004 **Reed, S. J. B.** Chemical and mineralogical evidence from iron meteorites on the nature of the parent body, *in* Mantles of the Earth and terrestrial planets (S. K. Runcorn, editor): London and New York, Interscience Publishers, p. 15–33, illus., table, 1967.

Composition and cooling rates of various iron meteorites suggest a parent body with dimensions comparable to asteroids. Marked differences in cooling rates among iron meteorites combined with systematic variation in Ga–Ge content point to a multiplicity of parent bodies. The very existence of iron meteorites proves that at one time they were molten, though details of their origin and history remain controversial.—JPF

01353 **Reinking, Robert Louis.** Geochemistry of the Iron Mountain magnetite deposit, Albany County, Wyoming [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 8, p. 3343B–3344B, 1968.

Reveal, James L. *See* Tidwell, William D. 07033

01189 **Reynolds, William R.** Mineralogy, stratigraphy, and origin of lower Tertiary clays and claystones of Alabama [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 546–547, 1968.

Rhodes, F. H. T. *See* Downie, C. 07057

01496 **Rib, Harold T.** Remote sensing applications to highway engineering: Public Roads, v. 35, no. 2, p. 29–36, illus., 1968.

In recent years, the availability of new remote sensors—radar, infrared, multichannel—has initiated a new era in the application of interpretation techniques in highway engineering. The data provided by the many types of sensors furnish information previously obtainable, or available, only at great expense. In this paper, the areas of possible applications of remote sensors in the highway field are discussed. Several examples are included to demonstrate the value of remote sensors in various aspects of highway engineering. Also included is a discussion of the Public Roads research program in remote sensing.—Author's abstract

01611 **Rice, H. M. A.** Two Tertiary sawflies (Hymenoptera–Tenthredinidae) from British Columbia: Canada Geol. Survey Paper 67–59, 21 p., illus., 1968.

Two specimens of sawflies from the Tertiary beds of central British Columbia are in the paleontological collection of the Geological Survey of Canada. These belong to the family Tenthredinidae and subfamily Allantinae. One has been assigned to the genus *Eriocampa* and one to *Pseudosiobla* which seem to agree with the previous assignment of similar fossil species. These two specimens are similar to some previously described species from Florissant, Colorado, but until more specimens are found they seem to be sufficiently different to warrant assigning them to new species.—Author's abstract

01190 **Richards, Adrian F.; Keller, George H.** Measurement of shear strength, bulk density, and pore pressure in Recent marine sediments by *in-situ* probes—Results of 1967 shallow-water tests [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 547, 1968.

01548 **Richardson, S. W.; Bell, P. M.; Gilbert, M. C.** The aluminum silicates: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 392–397, illus., 1968.

The authors have determined 17 reversed brackets of kyanite–sillimanite equilibrium between 700° and 1500°C, and have shown that water has no effect on the position of the polymorphic transition. An independent knowledge of the temperature of the kyanite–sillimanite isograd, therefore permits the estimation of load pressure and hence depth of burial during metamorphism. Using temperatures measured from oxygen-isotope fractionation between minerals, they have shown that an area of Connecticut was metamorphosed under at least 6.5 kb pressure. Comparison of the kyanite–sillimanite isograd with a dehydration reaction isograd allows the calculation of both load and water pressure.—MST

01549 **Richardson, S. W.** The composition of synthetic Fe–staurolite: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 397–398, table, 1968.

The author has synthesized Fe–staurolite in an attempt to resolve the discrepancy between the composition $4FeO{\cdot}9Al_2O_3{\cdot}7\ 1/2SiO_2$ (molar proportions) and the "ideal" composition of Naray–Szabo and Sasvari (1958). The value 3.83 (OH) per formula unit is well within experimental uncertainty of the 4.0 (OH) in the postulated formula. Crystallographic methods will have to be used to decide whether the Náray–Szabó and Sasvári formula reflects the fundamental staurolite structure, and whether synthetic and natural staurolites do differ from the fundamental structure by the substitution $4H \rightleftarrows Si$.—MST

01550 **Richardson, S. W.** The stability of Fe–staurolite+quartz: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 398–402, illus., 1968.

An investigation is reported of the stability of Fe–staurolite+quartz in equilibrium with a fluid composition controlled by the quartz–fayalite–magnetite buffer. Results show that the association of staurolite with quartz in metamorphic rocks indicates fluid pressures to greater than 1.5 kb and that the characteristic absence of cordierite in some types of regional metamorphism indicates fluid pressures greater than 3.5 kb.—MST

Richardson, S. W. *See* Naldrett, A. J. 01558

Ride, W. D. L. *See* Butler, P. M. 07055

Riedel, W. R. *See* Banner, F. T. 07074

Rieke, Herman H., 3d. *See* Adamson, Lucas G. 07039

07035 **Rigby, J. Keith.** Sponges from the Silurian Laketown Dolomite, Confusion Range, western Utah: Brigham Young Univ. Geology Studies, v. 14, p. 241–244, illus., 1967.

Eight large root tuft(?) spicules document the first known occurrence of sponges in the Silurian Laketown Dolomite in Utah. They occur as part of a silicified brachiopod fauna in the upper part of the formation in King's Canyon, in the southern Confusion Range in western Millard County.—Author's abstract

07118 **Ritchie, James C.** Holocene vegetation of the northwestern precincts of the Glacial Lake Agassiz basin, *in* Life, land and water—Conference on environmental studies of the Glacial Lake Agassiz region, 1966, Proc.: Manitoba Univ. Dept. Anthropology Occasional Paper 1, p. 217–229, illus., tables, 1967.

Studies of the pollen spectra in Manitoba and Saskatchewan have shown the following pattern of plant development in the area since the evacuation by the ice. From 12,500 to 10,500 years ago, most of the area was occupied by a spruce soapberry forest on mesic sites, poplar and willow stands as seral communities on younger sites, and treeless areas by sage, grass, and locally juniper on the most xeric sites. At about 10,500 years ago, all the area was treeless and was a grassland. At about 3,500 to 4,000 years ago, the grassland was invaded from the north and the south by present-day forests.—HRC

Ritchie, W. D. *See* Barss, D. L. 01324

Rohrbacher, Timothy J. *See* Hatfield, Craig B. 01469

01484 **Romer, Alfred Sherwood.** An ichthyosaur skull from the Cretaceous of Wyoming: Wyoming Univ. Contr. Geology, v. 7, no. 1, p. 27–41, illus., 1968.

An ichthyosaur skull from the Mowry Shale of Wyoming—the only good ichthyosaur skull so far known from the Cretaceous—is described and figured. Study of the well-preserved temporal region leads to the conclusion that the dermal element usually described in ichthyosaur skulls above the quadratojugal is nonexistent; that, hence, the large element bounding the temporal opening is the true squamosal, and the opening is thus of a typical euryapsid pattern. Illustrations of a Liassic ichthyosaur prepared by D. M. S. Watson are appended.—Author's abstract

01489 **Rosenshein, J. S.; Gonthier, Joseph B.; Allen, William B.** Hydrologic characteristics and sustained yield of principal ground-water units, Potowomut-Wickford area, Rhode Island: U.S. Geol. Survey Water-Supply Paper 1775, 38 p., illus., tables, 1968.

The Potowomut-Wickford area in south-central Rhode Island contains a sand and gravel aquifer whose transmissibility ranges from <10,000 to >300,000 gpd per ft; areas of large transmissibility occur in four ground-water reservoirs in the Potowomut, Annaquatucket, and Pettaquamscutt River basins. In 1963 4 mgd was pumped from the Potowomut River reservoir; of this 1.4 mgd was obtained from influent seepage of streamflow from upstream reaches of the Hunt and Potowomut Rivers. This basin also contains an additional ground-water reservoir that is virtually untapped. The reservoir underlying the Annaquatucket River basin can safely sustain a yield of 3.6 mgd in exceptionally dry years, while that of the Pettauqamscutt River basin may be capable of a yield of 1.3 mgd although there is danger of salt-water intrusion in the southern part. Chemical quality from the aquifer is suitable for most purposes.—*from* Authors' abstract

01528 **Rosenshein, J. S.; Hunn, J. D.** Geohydrology and ground-water potential of Porter and La Porte Counties, Indiana: Indiana Div. Water Bull. 32, 22 p., illus., tables, geol. map, 1968.

Principal sources of ground water in the counties are unconsolidated Quaternary sediments, forming a single but complex hydrologic system of four units, locally more than 400 feet thick. Potential ground-water yield of the area is estimated at 900 mgd, of which about 12 is being pumped. The basal unit 4 consists of clay till containing discontinuous zones of sand and gravel, used locally for domestic and farm water supplies. Unit 3, a sand and gravel and the principal aquifer, is about 15 percent artesian; estimated potential yield of the water-table part is 700 mgd. Unit 2, a silt till, is the confining layer for the artesian part of the principal aquifer, and may have as much as 2 million acre-feet of water in storage. Unit 1, a sand with local zones of gravel, is chiefly a water-table aquifer.—ESL

01608 **Rosenshein, J. S.; Hunn, J. D.** Geohydrology and ground-water potential of Lake County, Indiana: Indiana Div. Water Bull. 31, 36 p., illus., tables, geol. map, 1968.

Principal sources of ground water in Lake County are within the upper 350–400 feet of strata, a single but complex hydrologic system that consists of three aquifers and two confining layers, with a potential yield of 200 mgd. The upper 100 feet of Silurian dolomite forms the lowest aquifer, confined by a clay till. A sand forms the principal Pleistocene aquifer, partly artesian, with a potential yield of 60 mgd; it is susceptible to contamination, and in places is dewatered by ditching. A clay till is the confining layer, which discharges about 100 mgd to streams and ditches during the nongrowing season. A sand, a water-table aquifer, is the uppermost unit in the system; potential yield is about 30–40 mgd; it also is susceptible to contamination. A geologic map, ground-water maps, and maps showing depth to bedrock and to top of unit 3 accompany the report.—ESL

01643 **Ross, Stanley H.** Metallurgical beginnings—The case for copper in the prehistoric American Southwest: Assoc. Am. Geographers Annals, v. 58, no. 2, p. 360–370, 1968.

Indications of a pre-Columbian copper industry in the American Southwest are analyzed in terms of Old World findings and possible theories of metallurgical origins. These theories are tested in terms of the prehistoric level of knowledge about the Southwestern environment and the technological means of exploiting it. Knowledge of working of raw copper and copper minerals, utilization of charcoal and coal, the ability to mine, and the existence in the area of cast copper objects all indicate that metallurgy could have been practiced prehistorically in this area.—Author's abstract

01191 **Rothwell, W. T., Jr.** Mirror image of climate-caused foram extinction—Pacific and Gulf coasts [abs.]: Am. Assoc. Petroleum Geologists, Bull., v. 52, no. 3, p. 547–548, 1968.

Rowell, A. J. *See* Ager, D. V. 07073

01192 **Royse, Chester F., Jr.** Sedimentologic analysis of Tongue River and Sentinel Butte Formations (Paleocene), western North Dakota [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 548, 1968.

Rubin, Meyer. *See* Hanshaw, Bruce B. 07052

01614 **Rucklidge, John; Stumpfl, E. F.** Changes in the composition of petzite (Ag_3AuTe_2) during analysis by electron probe: Neues Jahrb. Mineralogie Monatsh. 1968, nos. 1–2, p. 61–68, illus., 1968.

Under electron bombardment in the microprobe, petzite, a mineral with low electrical conductivity, develops an electrical field gradient up which Au diffuses rapidly and is replaced by Ag. A temperature increase occurs simultaneously, so that the stable phase in the impact area becomes the Ag-rich "x" phase reported by Cabri (1965). The temperature developed cannot be estimated closely, but intuitively it might be expected to be in the 200°–300° range.—D.B.V.

07002 **Runcorn, S. K.** (editor). Mantles of the Earth and terrestrial planets: London and New York, Interscience Publishers, 584 p., illus., tables, 1967.

Papers in this volume were presented at a NATO Advanced Study Institute, University of New Castle-upon-Tyne, England, 1966. They are grouped under the following headings: evidence from meteorites and cosmochemistry, determination of basic physical constants of the planets, radial variation of physical properties in planetary interiors, physical evidence for nonhydrostatic conditions in the planets, planetary rotation, origin of the Moon, geochemical evidence on the nature of the Earth's mantle, surface evidence relating to planetary evolution, and thermal convection in planets. Pertinent papers are cited separately. Author and subject indexes are included.—MCM

07012 **Runcorn, S. K.** A palaeontological measurement of the rate of retreat of the Moon from the Earth, *in* Mantles of the Earth and terrestrial planets (S. K. Runcorn, editor): London and New York, Interscience Publishers, p. 225–228, 1967.

Astronomic measurement of lunar tidal friction and its effect on secular deceleration of the Earth's rotation has been supplemented by paleontologic observations on the Earth's rotation in the geologic past. Growth increments have been identified and counted on the epitheca of rugose corals, revealing 400 days in the Devonian year. Provided that the lengths of both day and month are known for any geological period, changes in the Earth's rotation due to lunar tidal friction torque can be calculated and separated from changes due to other causes.—JPF

07102 **Runcorn, S. K.** Convection in the planets, *in* Mantles of the Earth and terrestrial planets (S. K. Runcorn, editor): London and New York, Interscience Publishers, p. 513–524, illus., 1967.

The development of the theory that convection currents exist in the Earth's mantle is reviewed. The satellite geoid may be useful in deriving the distribution of the currents so that mathematical discussion is possible. Recent evidence suggesting that the Moon, Mars, Mercury, and Venus are each out of hydrostatic equilibrium implies the possibility of convection in all these terrestrial planets.—JPF

07115 **Rush, F. Eugene; Glancy, Patrick A.** Water-resources appraisal of the Warm Springs-Lemmon Valley area, Washoe County, Nevada: Nevada Dept. Conserv. and Nat. Resources Water Resources-Reconn. Ser. Rept. 43, 70 p., illus., tables, 1967.

The Warm Springs-Lemmon Valley area in western Nevada covers about 900 sq mi and includes 11 valleys. Younger and older alluvium of the valleys form the valley-fill reservoir and are the principal sources of ground water; maximum thickness in places is 1,000 feet. Inflow is from precipitation, runoff, imported water, and inflow of ground water through consolidated rock and alluvium. Additional water for consumption in the future will have to be from ground-water sources or imported from outside the area. Very few large-capacity wells have been drilled; accordingly test drilling and test pumping should precede any attempt to obtain a large ground-water supply. Some water is not fit for human consumption.—MCM

Rushforth, Samuel R. *See* Tidwell, William D. 07033

Russell, D. E. *See* Butler, P. M. 07055

01475 **Rust, B. R.** Deformed cross-bedding in Tertiary-Cretaceous sandstone, Arctic Canada: Jour. Sed. Petrology, v. 38, no. 1, p. 87-91, illus., 1968.

A 300-meter-thick section of Eureka Sound Formation beds north of Stanwell-Fletcher Lake, Somerset Island, contains well-sorted fine-grained quartz sandstone beds in which deformed crossbedding occurs. It is concluded that the deformation was caused by variable drag exerted on individual beds by flowing masses of sediment following current scouring action upstream. The gradational change in a single bed, from ordinary stream crossbedding at the base of the bed to an overturned fold at the top suggests that the sediment flow occurred at or just above standing water level.—RAC

01661 **Ryba, Earle.** The history of crystallography: Earth and Mineral Sci., v. 37, no. 6, p. 49-54, illus., 1968.

Since Nicolaus Steno (1669) refuted the popular thesis that minerals grew as "any other living thing", there have been three stages of development in the field of crystallography: (1) 17th-18th century observation, classification, and speculation; (2) 19th century theoretical foundation on geometry, triggered by Haüy's concept of repetition in crystal structure; and (3) 20th century experimental verification, after discovery of X-ray diffraction of crystals by von Laue in 1912. Contemporary crystallographers have again entered stage 1; however, new techniques and rapid development of equipment since World War II have put structure analysis on an automated basis.—GDC

01466 **Sahu, Basanta K.** Discussion of the article "Grain size measurement in thin section and in grain mount", by R. E. Smith [1966]: Jour. Sed. Petrology, v. 38, no. 1, p. 266-268, illus., 1968.

Contrary to the implications in the paper being discussed (ibid., v. 36, p. 841-843, 1966), the size difference, in phi units, between the same grain population measured on a grain mount and measured in thin section is theoretically constant for populations of different mean size. Variation due to Type I, II, and III errors affects the results. An insufficient number of grains were measured.—RAC

01366 **Sainsbury, C. L.; Sweeney, John W.** Tin, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 435-437, illus., 1968.

Although no commercial deposits are now known in Appalachia, tin, as cassiterite, has been found in pegmatites in North and South Carolina and Alabama. Brief descriptions of their occurrences are given.—HRC

01421 **Sainsbury, C. L.; Kachadoorian, Reuben; Smith, Thomas R.; Todd, William C.** Cassiterite in gold placers at Humboldt Creek, Serpentine–Kougarok area, Seward Peninsula, Alaska: U.S. Geol. Survey Circ. 565, 7 p., illus., table, 1968.

Large amounts of cassiterite accompany placer gold in Humboldt Creek in the Serpentine–Kougarok area, Seward Peninsula, Alaska. Cassiterite has also been reported from other placer-gold workings nearby. To date, no cassiterite has been recovered commercially; chemical analyses of concentrates from Humboldt Creek show a tin content of 60 percent—a commercially saleable product. Recovery of a saleable tin product would increase the possibility for profitable operation of the gold placers. The cassiterite is intergrown with vein quartz without any noticeable sulfide minerals; the grains occur in size and quantity that suggest a nearby lode source worth the effort of a search to find it.—Authors' abstract

07053 **Sainz Ortiz, Ignacio.** L'affaissement du sol de Mexico par suite du pompage excessie de la nappe [abs. (also English text)], *in* Hydrology of fractured rocks—Dubrovnik Symposium, 1965, Proc., V. 2: Internat. Assoc. Sci. Hydrology Pub. 74, p. 665–671, illus., 1967.

01451 **Salas, Guillermo P.** Petroleum evaluation of north-central Mexico: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 4, p. 665–674, illus., 1968.

Marine sedimentary rocks of the Mexican geosyncline, including neritic platform and bathyal zones, have a volume of 1,325,000 cu km and a potential reserve of 14,310 million bbl of oil which possibly formed in Cretaceous and Jurassic strata. Igneous activity and locally intense structural deformation of north-central Mexico did not necessarily affect migration and accumulation of petroleum. The area enclosing the Coahuila peninsula, southward to San Luis Potosi and westward to the Sierra Madre Occidental, must be explored geologically in more detail. Ancient neritic zones have the best possibilities for commercial petroleum accumulation.—WLA

07068 **Salwen, Bert.** A comment on [K.O.] Emery and [R.L.] Edwards' "Archaeological potential of the Atlantic continental shelf" [1966]: Am. Antiquity, v. 32, no. 4, p. 546–547, 1967.

Salwen agrees generally with the major conclusions of Emery and Edwards (ibid., v. 31, no. 5, pt. 1, p. 733–737, 1966), but comments on two points: (1) Absence of shellfish debris from some of the Archaic sites can be explained by local environmental factors (sites presently on the coast were a considerable distance inland during earlier occupations), rather than by the old, repeated suggestion of the "failure of the local inhabitants to learn to eat marine mollusks." (2) The list of archeological sites now under water can be considerably expanded; four additional sites in New England are discussed. In contrast to Emery and Edwards' warning that materials at many underwater sites may have been scattered by the surf zone, Salwen points out that at some of these sites artifactual materials have been protected by development of peat layers over the occupation areas.—VMJ

01193 **Sanderson, George A.; Verville, George J.** Morphologic variability of genus *Schwagerina* in Permian Wreford Limestone of Kansas [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 548, 1968.

07029 **Sanderson, Ivan D.** Lithology and petrography of the Virgin Limestone (Lower Triassic) at Blue Diamond Hill and vicinity, Clark County, Nevada: Brigham Young Univ. Geology Studies, v. 14, p. 123–130, illus., 1967.

Interbedded limestones, claystones, shales, and dolostones comprise the Virgin Limestone (Lower Triassic, and part of the Moenkopi) in 5 measured stratigraphic sections at Blue Diamond Hill and vicinity, west of Las Vegas, Clark County, Nev. Within these sections which aggregate from 750 to about 1,000 feet in thickness, limestones of oolitic, pelletal, oopelletal, micritic, skeletal, algal stromatolitic, algal

oncolitic, and pelecypod coquinite varieties, along with dolomicrites, form prominent ledges, while claystones and shales form slopes and benches. The area of investigation is about 20 miles west of the Las Vegas hinge line, and therefore sediments which accumulated in this region are interpreted as a shallow marine environment, possibly proximal to the basin which was farther west.—Author's abstract

01622 **Sanford, Allan R.** Gravity survey in central Socorro County, New Mexico: New Mexico Bur. Mines and Mineral Resources Circ. 91, 14 p., illus., table, 1968.

A detailed gravity survey covering parts of the Rio Grande depression and adjacent areas in central Socorro County, New Mexico, is described. Regional and residual Bouguer anomaly maps are presented and qualitative and quantitative interpretations of the results are made. Principal results are that (1) the Rio Grande valley is a series of linked structural depressions that can be quite asymmetrical in cross section, (2) other structural lows as significant as the Rio Grande depression exist in the region, and (3) recent earthquake activity near Socorro does not originate along the major normal faults bordering the depressions.—Author's abstract

01194 **Sanford, John T.; Mosher, Robert E.** Analytical approach to Niagaran stratigraphy, Michigan basin [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 548–549, 1968.

07067 **Sanger, David.** Prehistory of the Pacific Northwest Plateau as seen from the interior of British Columbia: Am. Antiquity, v. 32, no. 2, p. 186–197, illus., tables, 1967.

Recent excavations in south-central British Columbia have revealed a 7,500 year sequence [based on 11 C-14 dates from about 5580 B.C. to A.D. 1640 in the Lytton–Lillooet region] which indicates cultural relationships with the subarctic and the Canadian Prairie Provinces, but few similarities with Columbia River sites until after A.D. 1000. South-central British Columbia and the Columbia Plateau are considered to have had different cultural traditions until damming of the Columbia River [by the Cascade Landslide] about A.D. 1250 allowed upriver passage of salmon. Similarities between British Columbia and Columbia River sites in late prehistoric times may be attributable to the sudden increase in the resource potential of the Columbia River.—*from* Author's abstract

Saunders, R. S. *See* Mutch, Thomas A. 01463

Savage, E. L. *See* VanHouten, F. B. 01405

01404 **Savage, E. Lynn.** The Triassic rocks of the northern Newark Basin, Trip C *in* Guidebook to field excursions—New York State Geol. Assoc., 40th Ann. Mtg., Flushing, N. Y., 1968: Brockport, N. Y., State Univ. Coll., Dept. Geology, p. 49–68, illus., 1968.

Outcrops to be visited have been selected to illustrate some of the problems involved in the interpretation of Triassic rocks in the area. Although it is generally accepted that much of the Triassic has been removed by erosion, there are two contrasting ideas as to whether the present northeastern end of the Newark Basin marks the former extent of the sediments: (1) the present outcrop area is almost the same as the original extent, or (2) the sediments were once much more extensive, covering the area between the New Jersey–New York Trough and the Connecticut Trough.—*from* Author's introduction

Savage, R. J. G. *See* Butler, P. M. 07055

01668 **Savin, Samuel Marvin.** Oxygen and hydrogen isotope ratios in sedimentary rocks and minerals [abs.]: Dissert Abs., Sec. B, Sci. and Eng., v. 28, no. 7, p. 2906B, 1968.

Schairer, J. F. *See* Huckenholz, H. G. 01537

Schairer, J. F. *See* Tilley, C. E. 01566

Schairer, J. F. *See* Brown, G. M. 01568

01569 **Schairer, J. F.; Tilley, C. E.; Brown, G. M.** The join nepheline–diopside–anorthite and its relation to alkali basalt fractionation: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 467–471, illus., 1968.

From the phase-equilibrium diagram, 34 compositions were selected for study by quenching at one-atm. pressure; all compositions studied yield melilite as a solid phase at some stage. Solid solutions with compositions that do not lie in the join were produced, and assemblages developed have their analogs in the more complex natural alkali basaltic rock suites. Olivine reaction plays a very significant role in this fractionation. A modified flow sheet for rocks containing anorthite-rich plagioclase is given. Continued experimental study and investigation of the systems albite–anorthite with akermanite and other members of the melilite group are needed.—ESL

01656 **Scheffel, Mildred D.** Fossil collecting sites in the Normal, Illinois,area: Earth Sci., v. 21, no. 3, p. 101–109, illus., 1968.

This list of fossil collecting sites has been compiled for the benefit of visitors to the American Federation of Mineralogical Societies show in Normal, Ill., Aug. 1968. Five sites are described, four of them west of Peoria in Pennsylvanian strata, and a Devonian one, about 140 miles northwest of Normal, in the Cedar Valley Formation. Much of the area is covered by glacial drift, hence collecting is done in strip mines, quarries, or an occasional outcrop. Species to be found are illustrated.—GDC

Scheidegger, A. E. *See* Liao, K. H. 01626

Scheidegger, A. E. *See* Sturgul, J. R. 07139

07105 **Schilling, J. G.; Winchester, J. W.** Rare-earth fractionation and magmatic processes, *in* Mantles of the Earth and terrestrial planets (S. K. Runcorn, editor): London and New York, Interscience Publishers, p. 267–283, illus., tables, 1967.

Rare-earth abundance patterns in basic igneous rocks are varied but give remarkably smooth curves. Possible causes of smooth rare-earth fractionation in basic silicate materials in the Earth by extraction processes involving solid–liquid equilibria are considered. Highly differentiated igneous rocks may be explained by processes responsible for different rare-earth abundance patterns which include fractional crystallization, partial melting, zone melting, and mixing. Lines of further investigation are suggested.—JPF

07085 **Schlesier, Karl H.** Sedna Creek—Report on an archaeological survey on the Arctic slope of the Brooks Range: Am. Antiquity, v. 32, no. 2, p. 210–222, illus., table, 1967.

In 1964, many heavily patinated artifacts were found on and beneath the flood-plain surface of Sedna Creek, about 50 miles northwest of Anaktuvuk Pass, Alaska. The flakes and flake tools all belong to one cultural level. Sedna Creek is the fourth discovered site of the British Mountain complex, the oldest known tradition of Arctic America; the other three are Engigstciak, Katakturuk River, and Kogruk, all located in the Brooks Range or near the Arctic coast. No radiocarbon dates are available, but MacNeish (1964) has suggested a date of 16,000 B.C., considering the antiquity of five sites in the interior of Siberia to which the British Mountain sites are closely related. They are not closely related to any sites of lower North America, apparently because the expansion of the Wisconsin ice prevented southward migration from unglaciated Alaska at that time.—VMJ

01195 **Schmalz, Robert F.** Evaporite deposition in deep water [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 549, 1968.

07031 **Schneider, Michael C.** Early Tertiary continental sediments of central and south-central Utah: Brigham Young Univ. Geology Studies, v. 14, p. 143–194, illus., 1967.

The Cedar Breaks Formation (new name), from Cedar Breaks and Bryce Canyon National Parks, is correlated with similar strata near Richfield, Utah, primarily on the basis of two persistent mica zones enclosing white cliff and slope units near the top of the formation and on zones of tubular fillings, seeds, ball structures, and similar gross lithology and contacts. The formation was deposited in a fluctuating lacustrine environment in both areas; the material becomes coarser to the west, as well as thicker. The formation is correlated with the Flagstaff Formation farther north in the Valley Mountains. The Brian Head Formation overlies the Cedar Breaks in south-central Utah. Previously, both together had been called the Wasatch.—*from* Author's abstract

Schoonmaker, G. R. *See* Craig, D. H. 01233

Schot, Erik H. *See* Park, Won C. 01472

01546 **Schreyer, W.; Yoder, H. S., Jr.** Yoderite—Synthesis, stability, and interpretation of its natural occurrence: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 376–380, illus., 1968.

The authors have synthesized the high-pressure hydrous mineral yoderite, and investigated its relation to other phases in the MgO–Al_2O_3–SiO_2–H_2O system in the range 10–30 kb. Yoderite is stable at temperatures between about 750° and 875°C over a large pressure interval. At lower temperatures it breaks down principally to the assemblage kyanite+chlorite+talc; whereas at higher temperatures the breakdown assemblages are kyanite+pure Mg-staurolite+enstatite at high pressures, and other assemblages with the additional phases gedrite, corundum, cordierite, and liquid at lower pressures. The yoderite field extends down to pressures below 10 kb.—MST

01547 **Schreyer, W.** A reconnaissance study of the system MgO–Al_2O_3–SiO_2–H_2O at pressures between 10 and 25 kb: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 380–392, illus., 1968.

Mg-gedrite and Mg-staurolite have been synthesized for the first time in the present investigations. The stability of Mg-staurolite, the stability of pyrope in the presence of water, the upper pressure stability limit of the assemblage chlorite+quartz, the upper pressure stability limit of Mg-cordierite, the synthesis of pure Mg-gedrite, and the stability of sapphirine are all discussed and data are presented in P-T diagrams.—MST

01443 **Schulz, Werner.** A simple and efficient way to teach spectroscopy: Jour. Geol. Education, v. 16, no. 2, p. 50–52, illus., 1968.

Teaching the usefulness of the spectrum of light for identification of elements in geology and astronomy is an important part of any earth science course. Student investigations in many schools exclude quantitative work because low-cost spectroscopes do not have a scale for measuring wavelength. This article lists some of the attempts which have been undertaken to measure wavelengths by use of diffraction gratings in conjunction with various types of scales, and specifically reports on a low-cost spectroscope with a transparent scale which can be read easily and fairly accurately. By setting up stations with a minimum amount of materials, all students in class can be confronted with continuous emission and absorption spectra within one laboratory period.—Author's abstract

01634 **Schwartz, Alan; Ponnamperuma, Cyril.** Phosphorylation of adenosine with linear polyphosphate salts in aqueous solution: Nature, v. 218, no. 5140, p. 443, illus., table, 1968.

Water-soluble polyphosphate salts have been considered as possible prebiological phosphorylating agents. This communication reports the synthesis of adenosine-

2′, 3′, and 5′-phosphates by the simple heating of aqueous solution of adenosine and linear polyphosphate salts.—DBV

01679 **Schwering, Felix K.; Peterson, David West; Levin, S. Benedict.** A model for electromagnetic propagation in the lithosphere: IEEE Proc., v. 56, no. 5, p. 799–804, illus., tables, 1968.

Propagation properties of a crustal waveguide are derived using a model where dielectric constant and conductivity increase with depth according to a simple algebraic relation. The model is more realistic and consistent with available geologic information and reasonable extrapolations of crustal properties than are previous models. The mathematical analysis leads to an explicit analytical solution in the form of a mode expansion, individual terms of which can be written in closed form. Numerical evaluation of the model leads to a total attenuation rate (for the dominant mode) of 0.256 dB per km for a frequency of 1 kHz. A geologically critical attribute of the model is a positive temperature gradient with depth as principal controlling influence on the electric profile. A temperature gradient lower than that used in constructing the model would reduce significantly the attenuation rate.—*from* Authors' abstract

01458 **Scoffin, Terence P.** An underwater flume: Jour. Sed. Petrology, v. 38, no. 1, p. 244–246, illus., 1968.

A portable powered flume used to study the effects of controlled bottom currents on organically bound carbonate sediments in their natural state on a shallow sea floor is described.—Author's abstract

01354 **Scott, Robert W.** Paleontology and paleoecology of the Kiowa Formation (Lower Cretaceous) in Kansas [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 8, p. 3344B, 1968.

Scott, William H. *See* Hansen, Edward. 01587

07046 **Scull, Berton J.** The Chamberlain Creek barite deposit, *in* Central Arkansas economic geology and petrology—Geol. Soc. America, Field Conf. 1967, Guidebook: Little Rock, Ark., Arkansas Geol. Comm., p. 19–21, illus., 1967.

In the 2700 sq mi barite region in the Ouachita Mts. and Gulf Coastal Plain of Arkansas, the Chamberlain Creek deposit in Hot Spring County is most important. Ordovician to Mississippian rocks are intruded by the Magnet Cove ring dike complex of Mesozoic age, and overlapped on the southeast by the Tertiary Midway Formation. The major barite deposit is in the Stanley Formation (Mississippian) in one of the southwest plunging synclines of the Zigzag Mts. Local structures have no appreciable effect on the concentration of ore except for its increase in grade along axes of some folds. Its age and origin are controversial. Ore production has declined since 1957.—GDC

07000 **SEPM, Gulf Coast Section.** Selected Cretaceous and Tertiary depositional environments—Field trip guidebook, Sept. 30–Oct. 1, 1967: [n.p.] Soc. Econ. Paleontologists and Mineralogists, Gulf Coast Sec., 50 p., illus., 1967.

This field trip, designed for two days, covering 175 miles and making 10 stops, begins near Belton, in Bell County and passes into McLennon, Falls, Milam, Burelson, and ends in Brazos County. Stops at various formations are described, and extensive faunas are listed.—HRC

01455 **Sevon, W. D.** First and second degree regression correlation of the size analysis statistical parameters of Trask, Inman, Folk and Ward, and Friedman: Jour. Sed. Petrology, v. 38, no. 1, p. 238–240, tables, 1968.

Correlations between all possible pairs of the results of four different methods of parameter calculation were very high for mean and standard deviation and significantly lower for skewness and kurtosis.—RAC

07135 **Sevon, W. D.** The Bowmanstown boulder field, Carbon County, Pennsylvania: Pennsylvania Acad. Sci. Proc., v. 40, no. 2, p. 90–94, illus., 1967.

A 3/4 mile–long field of subrounded matrix–enclosed Palmerton sandstone boulders averaging 1 to 2 feet in diameter occurs in the axial valley of an overturned anticline southeast of Bowmanstown, Carbon County, Pa. The field surface has a gradient of about 5° and is covered with vegetation except where the gravel, sand, and silt matrix has been removed by headward erosion. Field evidence indicates that the boulders were transported to their present positions from outcrops immediately to the north by rock–glacier creep, probably in Pleistocene time. Undisturbed spall rock and vegetation indicate no present motion.—Author's abstract

01534 **Shafer, George H.** Ground–water resources of Nueces and San Patricio Counties, Texas: Texas Water Devel. Board Rept. 73, 129 p., illus., tables, 1968.

Principal water–bearing units in Nueces and San Patricio Counties are in the Gulf Coast aquifer—Pliocene Goliad Sand and Pleistocene Lissie Formation and Beaumont Clay which crop out in belts roughly parallel to the coast and dip southeast. Ground water moves southeastward from areas of recharge to areas of discharge. During 1964 about 15.6 mgd was pumped for all purposes. Coefficient of transmissibility ranges from 1,500–24,000 gpd per ft. Small additional supplies are probably available for development without depleting the aquifer, particularly north and northwest of Sinton. Moderately saline water is available also if an economic demineralization process can be developed.—MCM

Shafiqullah, M. *See* Currie, K. L. 01633

01599 **Shamberger, Hugh A.** (compiler). A comprehensive water and related land resources plan for the State of Nevada—Inventory of printed information and data pertaining to water and related resources of Nevada: Nevada Dept. Conserv. and Nat. Resources Inventory Ser. 2, 144 p., 1967 [1968?].

This second publication in the inventory series prepared by the Center for Water Resources Research is the first inventory of printed information pertaining to Nevada's water resources together with related resources publications. Divided into two basic indexes, the alphabetical listing of authors includes names of agencies as well as individual authors and reference co–authors; the subject index groups papers alphabetically under subject matter, generally by name of senior author, but also by ground–water areas. The subject index does not cover every paper in the author index, but enough to meet most demands.—GDC

06984 **Sharma, G. D.** Depositional environments and sediments in southeastern Alaska [abs.], *in* Alaskan Sci. Conf., 17th, Anchorage, 1966, Proc.: Sci. Alaska 1966, p. 35–36, 1967.

Shattles, D. E. *See* Newcome, Roy, Jr. 01491

01355 **Shaw, Charles Ernest.** Geology and petrochemistry of the Milford area, Massachusetts [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 8, p. 3344B–3345B, 1968.

Sherif, M. *See* Bostrom, R. C. 01522

Shimp, N. F. *See* Mast, R. F. 01519

01439 **Shinn, E. A.** Practical significance of birdseye structures in carbonate rocks: Jour. Sed. Petrology, v. 38, no. 1, p. 215–223, illus., 1968.

Two kinds of birdseye structure, both generally filled with calcite or anhydrite, are found in Recent and ancient carbonate rocks: (1) planar isolated vugs 1 to 3 mm high by several millimeters in width, and (2) isolated more or less bubblelike vugs, 1 to 3 mm in diameter. Laboratory experiments and observations in limestone quarry tailings suggest that the first kind results from shrinkage due to desiccation of exposed sediments and that the second kind is formed by gas bubbles. Study of many samples of Recent carbonate sediment shows that birdseye voids are

preserved in supratidal and intertidal sediment, but never occur in subtidal sediments. Birdseye structure thus may be an indicator of depositional environment.—HEC

Shirley, L. E. *See* Lesure, F. G. 01369

06988 **Shumaker, Robert C.** Bedrock geology of the Pawlet quadrangle, Vermont—Pt. 1, Central and western portions: Vermont Geol. Survey Bull. 30, p. 1–59, illus., geol. maps, 1967.

Taconic rocks of the Pawlet quadrangle are tightly folded, faulted and metamorphosed Cambrian and Ordovician argillite and graywacke, deposited in a trough on the Champlain shelf or seaward on the Magog eugeosyncline margin. Absence of facies changes either in marginal Taconic sediments or Champlain carbonates suggests an intermediate site. A large recumbent "Taconic fold" probably developed during Middle Ordovician and was thrust westward as a detached sheet during Trenton time onto sediments of the Champlain miogeosyncline, the final stage accompanied by shearing into a series of imbricate thrust plates. Superimposed post-Taconic (perhaps as late as Devonian) folds, faults and cleavage often conceal earlier structural features; axial plane fracture generally dips steeply eastward. Near the Green Mountain anticlinorium, folds in Shelburne and younger sediments are nearly recumbent.—*from* Author's abstract

Simons, E. L. *See* Butler, P. M. 07055

06971 **Simpson, George Gaylord.** The meaning of evolution—A study of the history of life and of its significance for man: New Haven, Conn., and London, Yale Univ. Press, 368 p., illus., revised 1967; originally published 1948.

The book presents in expanded form the 25th series of Terry Lectures delivered at Yale University, November 1948. The text is in three parts: course of evolution, interpretation of evolution, and evolution, humanity, and ethics. The first part is divided into nine chapters: geologic time, beginnings of life, major outlines of the fossil record, history of the vertebrates, records and radiations of reptiles, outlines of the history of mammals, history of the primates, rates of evolution, and first conclusions from the record. Part 2 is divided into seven chapters: the problem of problems, oriented evolution, opportunism of evolution, racial life and death, forces of evolution and their integration, concept of progress in evolution, and historical retrospect. Man's place in nature, the search for an ethic, ethics of knowledge and responsibility, and the future of man and of life, comprise part 3. An epilogue and summary conclude the book.—ESL

06977 **Sinclair, I. G. L.** Geochemical stream sediment survey of the Yallahs Valley: Jamaica Geol. Survey Econ. Geology Rept. 1 (Pub. 100), 4 p., illus., geol. map, 1967.

The Yallahs Valley was chosen for a detailed geochemical prospecting survey because of a favourable geological setting and the presence of mineral showings. Stream sediment samples were collected at intervals of approximately 500 feet and their minus eighty mesh portions analysed for copper, lead, nickel, and zinc. Interesting copper and nickel anomalies were located as a result of this work and these are now being investigated in detail. No significant lead or zinc anomalies were located.—Author's abstract

07049 **Siple, George E.** Salt-water encroachment of Tertiary limestones along coastal South Carolina [with French abs.], *in* Hydrology of fractured rocks—Dubrovnik Symposium, 1965, Proc., V. 2: Internat. Assoc. Sci. Hydrology Pub. 74, p. 439–453, illus., 1967.

Eocene-Miocene limestone and Paleocene-Eocene clastic sediments constitute major water-bearing formations along coastal South Carolina which have been invaded during Recent and past geologic epochs by sea water. Deposits of low regional dip are probably discharging water of Pleistocene or earlier age. Upper zones of Eocene limestones, incised by estuaries during Pleistocene and Recent time, are now subject to salt-water encroachment, which is also thought to occur along the subsea

contact of the Eocene and Oligocene deposits. Most extensive encroachment presently recognized occurs both in Tertiary limestones and Cretaceous clastic beds extending in an arcuate belt from the Beaufort Basin to areas adjacent to the Cape Fear Arch. These artesian aquifers have fresh-water heads ranging from altitudes of −3 to +49 m and maximum chloride concentrations of about 8,500 ppm.—*from* Author's abstract

Slaughter, Bob H. *See* McNulty, C. L., Jr. 01179

01196 **Sloss, L. L.** Simultaneous evaporite–carbonate deposition? [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 549–550, 1968.

01642 **Smith, F. A.; Weakly, E. C.** Groundwater data, Polk County, Nebraska: Nebraska Water Survey Paper 22, 40 p., illus., tables, 1968.

About half of Polk County lies in the Platte River basin and the remainder in the upper part of the Big Blue River basin. Ground water is one of the most important resources; about 71,000 acres of land were irrigated with water from wells in 1965. This report includes descriptions of samples taken from a water-level observation well drilled in 1959, descriptions of irrigation and municipal wells, and records of depths to water in 53 wells. Chemical analyses of water from nine wells are given.—MCM

Smith, Lee A. *See* Gartner, Stefan, Jr. 06958

01356 **Smith, Norman Dwight.** A stratigraphic and sedimentologic analysis of some Lower and Middle Silurian clastic rocks of the north-central Appalachians [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 8, p. 3345B, 1968.

Smith, R. I. *See* Hemphill, Charles R. 01216

01467 **Smith, Richard E.** Grain size measurement in thin section and in grain mount—Reply to comment by Sahu [1968]: Jour. Sed. Petrology, v. 38, no. 1, p. 268–271, illus., 1968.

Size differences obtained in measuring the same population in grain mount and in thin section are logarithmically constant for populations of different mean size but vary arithmetically. Variation present due to concepts considered and methods used has not been shown by Sahu [ibid., p. 266–268] to be significant.—RAC

Smith, Thomas R. *See* Sainsbury, C. L. 01421

01521 **Smith, W. H.** Strippable coal reserves of Illinois—Pt. 6, LaSalle, Livingston, Grundy, Kankakee, Will, Putnam, and parts of Bureau and Marshall Counties: Illinois Geol. Survey Circ. 419, 29 p., illus., tables, 1968.

Strippable reserves are defined as coal 18 inches or more thick with overburden not exceeding 150 feet. Maps scaled at 1/2 in. to 1 mi show coal outcrops, mined-out areas, coal thickness, and overburden thickness at intervals of 0 to 50, 50 to 100, and 100 to 150 feet. The structure on top of the Colchester (No. 2) Coal is shown on a smaller scale map. Strippable reserves were estimated and are mapped in detail for the Colchester, Summum, Herrin, and Danville Coals. Several nonpersistent coals at strippable depth are described. Geology and stratigraphy of the principal coal deposits are described briefly and illustrated by cross sections. The quantity of strippable coal, categorized by thickness and overburden and reliability of estimates is tabulated by township for each county. Approximately 734 million tons of strippable coal reserves are estimated.—*from* Author's abstract

Smout, A. H. *See* Banner, F. T. 07074

Sohl, Norman F. *See* Owens, James P. 01403

01425 **Soister, Paul E.** Geologic map of the Hanover NW quadrangle, El Paso County, Colorado: U.S. Geol. Survey Geol. Quad. Map GQ-725, scale 1:24,000, sections, text, 1968.

Deposits of economic interest in the Hanover NW quadrangle include coal, sand and gravel, and subsurface water. Coal beds occur in the upper Laramie Formation which is covered by Quaternary alluvial and eolian deposits in most of the area. Quaternary sand and gravel deposits have been worked locally for road metal. Subsurface water is important to agriculture as there are no perennial streams; scattered wells producing from a few hundred to more than a thousand gpm are used for irrigation and stock watering in the northeastern and southwestern sections. Large amounts of water are generally limited to the deepest parts of the Quaternary paleochannels.—MCM

07096 **Southeastern Geological Society; Brooks, H. K.; Underwood, J. R., Jr.** (editors). Miocene–Pliocene problems of peninsular Florida—13th Field Trip, February 1967 [guidebook]: Tallahassee, Fla., Southeastern Geol. Soc., 43 p., illus., tables, 1967.

The road log contains essential comments and data on correlation and environment for each stop, and a measured stratigraphic section. It is suggested that the term Hawthorn Group be used for the lower Miocene to Pliocene strata when mappable units exist within it. A reprint of Pirkle et al (1965) has been inserted; papers by T. H. Patton and S. D. Webb are cited separately.—ESL

06999 **Speidel, David H.; Heald, Emerson F.** Gaseous equilibria in portions of the system C–H–O–S: Pennsylvania State Univ. Earth and Mineral Sci. Expt. Sta. Bull. 83, [65] p., tables, 1967.

The problem is to determine the chemical equilibria of the gaseous species as a function of temperature, and a set of mixing ratios of the gases. The values of partial pressure for the 14 inorganic gaseous species in the system, calculated for the various conditions, are given in negative logarithmic form. Tables 1 through 6 represent values calculated for a given volume percent SO_2 in the vapor phase, 0.25, 0.50, 0.75, 1.00, 2.00, and 3.00. Horizontal rows within each table give values for temperatures from 500° to 1550° C at 50° intervals. Vertical columns give values for log CO_2/H_2, between 2.0 and 0.0 at 0.2 intervals. All results are at 1 atm pressure. Table 7 gives starting compositions in terms of gram atoms. Resulting values of log pS_2 for varying values of SO_2 volume percent in the initial mixture are represented in Table 8.—ESL

01495 **Spieker, Andrew M.** Future development of the ground-water resources in the lower Great Miami River valley, Ohio—Problems and alternative solutions: U.S. Geol. Survey Prof. Paper 605-D, p. D1–D15, illus., 1968.

Valley-train sand and gravel aquifers of the Great Miami River valley below Dayton, Ohio, can yield nearly three times present withdrawal (110 mgd) provided future developments are sufficiently distant from present pumping centers. Ground water returned to the river as sewage could be recycled as induced recharge, amount of recycling limited by deterioration of quality or cost of treatment. Greatest future problems will be declining ground-water levels and local overdraft resulting from increased water use, ground-water contamination, and application of existing law to situations involving water rights. Overdraft can best be avoided by spacing and location of future developments; water reuse by industry is an alternative to development of new supplies, and ground-water contamination can be controlled by maintaining good quality water in streams.—*from* Author's abstract

01197 **Stanley, Thomas B., Jr.** Vicksburg fault zone, Texas [abs.]: Am. Assoc. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 550, 1968.

Stansfield, Robert F. *See* Bergendahl, M. H. 01379

Stansfield, Robert G. *See* Newman, William L. 01326

Stansfield, Robert G. *See* Lesure, F. G. 01327

Stansfield, Robert G. *See* Wedow, Helmuth, Jr. 01328

Stansfield, Robert G. *See* Luttrell, Gwendolyn W. 01330

Stansfield, Robert G. *See* Butler, Arthur P., Jr. 01365

Stansfield, Robert G. *See* Maxwell, Charles H. 01387

Stansfield, Robert G. *See* French, Alice E. 01389

Stansfield, Robert G. *See* Conant, Louis C. 01397

07094 **Stearns, Richard G.; Milici, Robert C.** Sequatchie anticline, *in* A field guide to Carboniferous detrital rocks in northern Alabama—Geol. Soc. America, Coal. Div., 1967 Field Trip: University, Ala., Alabama Geol. Soc., p. 28–32, illus., 1967.

The Sequatchie anticline is related to the Cumberland Plateau overthrust system and is part of a good example of thin-skinned tectonics. The anticline is a superficial fold over a rising thrust fault. The upper plate, containing the anticline, may extend southward into Alabama from Tennessee. The structure is post-Pennsylvanian in age, and may be controlled by the western limits of Cambrian shale. Several cross sections show the relationships.—HRC

07065 **Stephenson, Robert L.** Frank H. H. Roberts, Jr., 1897–1966: Am. Antiquity, v. 32, no. 1, p. 84–94, portrait, 1967.

01198 **Stevens, Calvin H.** Water-depth control of fusulinid distribution [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 550, 1968.

01652 **Stewart, F. H.** Geochemistry of marine evaporite deposits [abs.], *in* Saline deposits—Internat. Conf. Saline Deposits, Houston, Tex., 1962, Symposium: Geol. Soc. America Spec. Paper 88, p. 539–540, 1968.

01199 **Storey, T. P.** Evaporite basin configuration—Structural *versus* sedimentary interpretation [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 550–551, 1968.

07026 **Stotzky, G.** Clay minerals and microbial ecology: New York Acad. Sci. Trans., ser. 2, v. 30, no. 1, p. 11–21, 1967.

In soils of known disease history from banana plantations of Central American countries, Colombia, Ecuador, and the Cameroons, subjected to chemical, physical, and mineralogical analyses, a high correlation was apparent between effective banana-producing life and the clay mineralogy, which tended towards montmorillonite in the montmorillonite-vermiculite series. In laboratory cultures montmorillonite stimulated the respiration of disease-spreading bacteria; the rate of increase was related to cation exchange capacity of particles rather than size, thus indicating that clay minerals exert a marked influence on the activity, ecology, and population dynamics of microorganisms in natural habitats, especially in soil. Once the mechanisms responsible are resolved, microorganisms may be controlled by manipulation of clay mineral composition.—GDC

Strangway, D. W. *See* McMahon, B. E. 01616

07040 **Stuckey, Jasper L.** Pyrophyllite deposits in North Carolina: North Carolina Div. Mineral Resources Bull. 80, 38 p., illus., table, 1967.

All known occurrences of pyrophyllite in North Carolina are found in seven counties of the Carolina Slate Belt, associated with volcanic-sedimentary rocks which consist of lava flows interbedded with beds of ash, tuff, breccia and shale or slate. The rocks vary in composition from acid to basic, and fall into three groups: felsic volcanics, mafic volcanics, and bedded argillites; they have been folded, faulted and metamorphosed, with cleavage that strikes northeast and dips northwest. The pyrophyllite deposits are irregular, oval, or lens-shaped in acid volcanic rocks of rhyolite to dacite type. Metasomatic replacement of the host rocks, by means of hydrothermal solutions under conditions of intermediate temperature and pressure, is indicated. Pyrophyllite reserves, while not large, are ample for several years for a variety of industrial uses. Mines and prospects are described briefly.—GDC

Stueber, A. *See* Krogh, T. E. 01585

Stumpfl, E. F. *See* Rucklidge, John. 01614

07139 **Sturgul, J. R.; Scheidegger, A. E.** Some applications of elastic notch theory to problems of geodynamics: Pure and Appl. Geophysics, v. 68, no. 3, p. 49–65, illus., tables, 1967.

This paper is concerned with the behavior of surface features of the Earth which are, or have been, acted on by a stress field; the theory used is that of classical elasticity. Mathematical models are made which represent perfectly elastic two-dimensional regions which have a notch (or protrusion as a reversed notch can be considered to be). The regions are assumed to be semi-infinite and the notch on the free surface. The loads, or boundary conditions, are then prescribed. Solutions to the problem of determining the distribution of stress are presented for the cases of a circular notch, a generalized circular notch and a type of notch whose mathematical representation is given parametrically. Using these solutions and applying a criterion for failure, it is possible to predict what the general trend of the faulting should be in an actual body which the model may represent. Possible applications to geological structures are indicated.—*from* Authors' abstract

07140 **Sturgul, J. R.** A complex variable technique to study notch-effects in geodynamics: Pure and Appl. Geophysics, v. 68, no. 3, p. 66–82, illus., tables, 1967.

The techniques of Complex Variables are used to obtain a solution for a general notch problem having a load distributed over any portion of its free surface. This solution is very general in that it can be used for many different shapes of notches, including protrusions, by simply varying a few parameters. The same techniques are then used to solve the problem of a notched plate acted on by loads at infinity. This solution is of a very general nature. One particular solution holds for the problem studied in an earlier publication.—Author's abstract

01483 **Surdam, Ronald C.** The stratigraphy and volcanic history of the Karmutsen Group, Vancouver Island, B.C.: Wyoming Univ. Contr. Geology, v. 7, no. 1, p. 15–26, illus., geol. map, 1968.

The Karmutsen Group is very thick, and is neither highly metamorphosed nor strongly folded. About 18,000 feet of rocks, divided into five mappable units, are present. The group conformably overlies Triassic(?) argillites and flows and is conformably overlain by the Upper Triassic Quatsino Formation. The minimum depth of burial of the Karmutsen was 5,000 feet, and the maximum was never greater than 20,000. The volcanic activity in the geosyncline was cyclic, and each cycle can be divided into four parts: (1) volcanic quiescence and limestone deposition, (2) accumulation of close-packed pillow lavas, pillow breccias, and aquagene tuffs, (3) extrusion of thin-layered flows, and (4) extrusion of thick layered flows.—*from* Author's abstract

01596 **Süsse, P.** Serendibite, space group and cell dimensions: Naturwissenschaften, v. 55, no. 4, p. 176, table, 1968.

Weissenberg photographs of serendibite from Warren County, New York, show a triclinic symmetry, space group $P\,1$ or $P\,\bar{1}$, and yield a reduced cell which contains two formula units. Least-squares refinement of the lattice constants was based on data obtained from back-reflection photographs. Crystallographic data are tabulated.—ESL

06983 **Swanston, D. N.** A late Pleistocene glacial sequence from Maybeso Creek valley, Prince of Wales Island, Alaska [abs.], *in* Alaskan Sci. Conf., 17th, Anchorage, 1966, Proc.: Sci. Alaska 1966, p. 35, 1967.

Sweeney, John W. *See* Wedow, Helmuth, Jr. 01331

Sweeney, John W. *See* Sainsbury, C. L. 01366

Sweeney, John W. *See* Wedow, Helmuth, Jr. 01373

Sweeney, John W. *See* Patterson, Sam H. 01375

Sweeney, John W. *See* Wright, Wilna B. 01380

Sweeney, John W. *See* Dorr, John Van N., 2d. 01381

Sweeney, John W. *See* Bush, A. L. 01384

Sweeney, John W. *See* Hosterman, John W. 01393

Sweeney, John W. *See* Meyer, Richard F. 01395

01417 **Swift, Donald J. P.; Jagodits, Frank L.; Manistre, Bernard L.; Paterson, Norman R.** Structure of the Minas Passage, Bay of Fundy—A preliminary report: Maritime Sediments, v. 3, no. 4, p. 112–118, illus., geol. map, 1967 [1968].

To test the feasibility of a tidal power station in Nova Scotia's Minas Passage, Bay of Fundy, a joint geological-geophysical study was undertaken. This paper presents a portion of the study, that of the complex structure of this critical area and its bearing on regional structure, with a map showing generalized bedrock contours and geology. The Cobequid fault is the key to the tectonics of the region; its best documented movement is transcurrent. The present reconnaissance suggests that after the middle Carboniferous, there was an important reverse component. The study area lies athwart a Triassic basin, a half-graben, superimposed on a larger Carboniferous basin which is the product of southward thrusting combined with dextral transcurrent movements. Subsidence and downwarping seem as important in its structural evolution as faulting.—GDC

07112 **Sykes, L. R.** The world-wide distribution of deep and shallow earthquakes [abs.], *in* Mantles of the Earth and terrestrial planets (S. K. Runcorn, editor): London and New York, Interscience Publishers, p. 383–384, 1967.

Szabo, F. *See* Hemphill, Charles R. 01216

01200 **Taft, William H.** Yellow Bank, Bahamas—A study of modern marine carbonate lithification [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 551, 1968.

06982 **Tanaka, James M.** Stabilization investigations of the Turnagain slide, *in* Alaskan Sci. Conf., 17th, Anchorage, 1966, Proc.: Sci. Alaska 1966, p. 27–33, 1967.

Five major earthquake-induced slides occurred in the Anchorage, Alaska area on March 27, 1964. The Turnagain slide extended along 8,000 feet of Knik Arm coastline; displacement was up to 500 feet horizontally and 30 to 40 feet vertically. Sample borings drilled at 42 locations, shear strength tests, and a trench across the slide show a zone of unusually weak material at a certain depth; contact of this with an underlying strong layer marks the failure zone. To provide a substantial increase in shear strength over a limited width, sand-drain stabilization, incorporating remolding of materials with explosives, and electro-osmosis, which did not reduce the sensitivity enough, were attempted. The strength within the slide zone is increasing with time, and the consideration has been reopened that the slide debris provides an adequate buttress if slopes are protected against beach erosion.—ESL

01201 **Tanner, William F.** Environmental indicators in Morrison Formation, New Mexico [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 552, 1968.

Tanner, William F. *See* Kirtley, David W. 01476

01535 **Tarver, George R.** Ground-water resources of Tyler County, Texas: Texas Water Devel. Board Rept. 74, 91 p., illus., tables, 1968.

Ground-water supplies underlying Tyler County are practically untapped. In 1964, withdrawals amounted to about 2.3 mgd as compared with 62 mgd being transmitted by the Jasper, Evangeline, and Chicot aquifers under the 1965 hydraulic gradient (5 feet per mile). The three aquifers contain about 80 million acre-feet in storage, of which 23 million acre-feet is stored in the upper 400 feet of the aquifers; fresh to slightly saline water is found to a depth of at least 2,945 feet below sea level. In the southern part where all three aquifers are present, net thickness of sands is as much as 1,000 feet; in the northern part, the Jackson Group and Catahoula sandstone are the only sources of good quality water. In the principal aquifers water is suitable for most purposes.—*from* Author's abstract

07078 **Tasch, Paul.** Fossil clam shrimp distribution and its significance for the theory of continental drift: Kansas Acad. Sci. Trans., v. 70 no. 2, p. 151–163, illus., 1967.

In this presidential address, a generalized review of the theory of continental drift is given, followed by a discussion of the biology and stratigraphy of Branchiopoda. Permian leaiids are present throughout the world (including Antarctica). Cyzicids appear in the Jurassic of Antarctica, East Africa, and India; a common gene pool, hence physical closeness, is implied. The Carboniferous leaiids of Africa and Australia are related. The distribution is explained by continental juxtaposition in the past.—HRC

01376 **Thayer, T. P.; Hobbs, Robert G.** Chromium, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 372–374, illus., table, 1968.

An extremely brief description of the occurrence of chromite in Appalachia is given. It occurs commercially only in western North Carolina, the deposits of which are described briefly. No new information is included, however.—HRC

07008 **Thirlaway, H. I. S.** New developments in seismology [abs.], *in* Mantles of the Earth and terrestrial planets (S. K. Runcorn, editor): London and New York, Interscience Publishers, p. 109–110, 1967.

Thomas, Franklin D. *See* MacQuown, W. C., Jr. 01448

07017 **Thomas, Harold E.** Determining perennial recharge, *in* Groundwater development in arid basins—Symposium, Utah State Univ., 1967, Proc.: Logan, Utah, Utah State Univ., p. 15–20, 1967.

Rate of recharge is commonly determined by figuring that total recharge to a ground-water reservoir equals total discharge from it, ± any changes in storage during the specified period. Areas studied in Utah were Cedar City, Parowan, and Escalante Valleys, and the East Shore area of Great Salt Lake. In the first two, tributaries with headwaters in the high plateaus contribute to recharge, but in Escalante, with a reservoir greater than the other two together, most of the tributary drainage basin is arid. Pumpage is heavy and water levels have declined, averaging under two feet a year since 1950. The East Shore area shows seasonal rises of water level due to recharge. Streams and irrigation canals furnish 30,000 acre-feet, precipitation, 10,000, and subsurface flow, 30,000. Flowing and pumping wells discharge 25,000 acre-feet, and an estimated 40,000 moves westward and is wasted by evaporation or goes into the lake.—ESL

07092 **Thomas, William A.** Mississippian facies in Alabama, *in* A field guide to Carboniferous detrital rocks in northern Alabama—Geol. Soc. America, Coal Div., 1967 Field Trip: University, Ala., Alabama Geol. Soc., p. 21–23, illus., 1967.

There are two major Mississippian lithofacies, limestone and clastic; the latter is generally south and southwest of the former. The facies boundary is gradational and extends southwestward across the Warrior basin into the Folded Appalachians. Near Birmingham it turns northeastward and parallels the structural trends. Northward, limestone more than 1,000 feet thick, is predominant. In the south the clastic section is nearly 4,000 feet thick in Cahaba basin. The great thicknesses coincide with structural troughs. Individual formations are discussed. A southwestward source for the sediments is indicated, and an eastward extension of

the Ouachita tectonic belt as a source is suggested. Some folding took place during the Mississippian. Depositional environments range from open shelf to coastal swamps.—HRC

06987 **Thompson, James B., Jr.** Bedrock geology of the Pawlet quadrangle, Vermont—Pt. 2, Eastern portion: Vermont Geol. Survey Bull. 30, p. 61–98, table, geol. maps, 1967.

Precambrian gneisses of the Mt. Holly Complex are unconformably overlain by Lower Cambrian metasedimentary rocks succeeded by about 3,500 feet of Cambrian and Lower Ordovician carbonate rocks. High-angle faulting, the Tinmouth Disturbance, was accompanied or followed by volcanic activity—newly named Baker Brook Volcanics. Middle Ordovician phyllites and limestones of the Ira Formation rest on an eroded surface and locally bared Precambrian blocks. The Taconic allochthon is structurally discordant; its phyllites and schists form the highest summits of the area. The herein named albitic Netop Formation underlies phyllites of the St. Catharine Formation. The Dorset Mtn. nappe is interpreted as an Acadian? gravity slide off the rising Green Mtn. front. Regional metamorphism overlapped the later stages of deformation; post-metamorphic mafic dikes are probably Mesozoic.—*from* Author's abstract

Thompson, W. B. *See* Allan, D. W. 07101

Thomson, Robert D. *See* Ericksen, George E. 01385

Thomson, Robert D. *See* Ericksen, George E. 01400

01357 **Thorpe, Ralph Irving.** Controls of hypogene sulfide zoning, Rossland, British Columbia [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 8, p. 3345B–3346B, 1968.

07033 **Tidwell, William D.; Rushforth, Samuel R.; Reveal, James L.** *Astralopteris*—A new Cretaceous fern genus from Utah and Colorado: Brigham Young Univ. Geology Studies, v. 14, p. 237–240, illus., 1967.

Astralopteris, a new fern genus from the Cretaceous Dakota Sandstone of extreme east-central Utah and southwestern Colorado is proposed. The genus, which includes one species, *A. coloradica*, based on *Bolbitis coloradica* Brown, is seemingly most closely related to *Drynaria* (Polypodiaceae) of southeastern Asia.—Authors' abstract

07044 **Tidwell, William D.** Flora of Manning Canyon Shale—Pt. 1, A lowermost Pennsylvanian flora from the Manning Canyon Shale, Utah, and its stratigraphic significance: Brigham Young Univ. Geology Studies, v. 14, p. 3–66, illus., tables, 1967.

Exposures on the east flank of Lake Mountain contain a unique, lowermost Pennsylvanian flora. *Crossopteris* gen. nov. is the most abundant form, with *Calamites* (*Mesocalamites*) occurring with high frequency. A total of 33 genera and 58 species are recognized, and fourteen new species and two genera, *Crossopteris* and *Rigbyocarpus*, are described; three new combinations are proposed also. Four species are reported from North America for the first time, and one new from the United States. The flora indicates a fresh or brackish swamp environment of deposition for the formation.—*from* Author's abstract

07077 **Tien, Pei-Lin.** An occurrence of rozenite in Kansas: Kansas Acad. Sci. Trans., v. 70, no. 2, p. 219–222, illus., 1967.

This naturally-occurring ferrous sulfate tetrahydrate,found on bedding planes of black shale from a core in a coal mine in Labette County, occurs as white aggregates associated with pyrite and minor amounts of melanite. X-ray data are given.—HRC

Till, Roger. *See* Davies, Peter J. 01454

01566 **Tilley, C. E.; Yoder, H. S., Jr.; Schairer, J. F.** Melting relations of igneous rock series: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 450–457, illus., tables, 1968.

Studies on the calcalkali volcanic series of Parícutin, Mexico, have been extended to cover a larger suite. Sr ratios of basalt and andesite are identical and characteristic of basalt, precluding origin of the andesite by assimilation of sialic material. Melting work on the tholeiitic volcanic series of Thingmuli, Iceland, as a fractional crystallization trend, is compared with earlier studies on the Kilauea, Hawaii, tholeiite succession. Liquidus determinations on border facies of layered igneous complexes have been extended to cover the Bushveld and Muskox intrusions, and an aphanitic facies of a zoned picrite basalt intrusion from Ubekendt Island, West Greenland. Data reinforce the need to reassess the concept of these rocks as parental material.—ESL

01567 **Tilley, C. E.; Yoder, H. S., Jr.** The pyroxenite facies conversion of volcanic and subvolcanic, melilite-bearing and other alkali ultramafic assemblages: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 457–460, illus., table, 1968.

Experiments have been carried out under pressures of 2, 5, and 10 kb and at temperatures ranging from 900° to 1200°C. Products of runs made without excess water are essentially pyroxenites, with clinopyroxene as the dominant phase and accessory phases biotite, hornblende, olivine, and magnetite. With excess water, there is prominent development of hornblende along with clinopyroxene. The disappearance of melilite, nepheline, and most of the olivine in the conversion indicates that the rocks were volcanic and subvolcanic facies, represented at depth by pyroxenites, or hornblende- and biotite-bearing variants. The pyroxene-bearing monticellite alnoite from Quebec may have originated by partial melting of an olivine pyroxenite at depth, and intrusion of the crystal mush to consolidate as the alnoite assemblages at higher levels.—ESL

Tilley, C. E. *See* Schairer, J. F. 01569

01202 **Tillman, Roderick W.; Ellis, Charles W.** Reversed-climbing ripples and sand-wave deposition in Arkansas River [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 552, 1968.

01657 **Tobisch, Othmar T.** Gneissic amphibolite at Las Palmas, Puerto Rico, and its significance in the early history of the Greater Antilles Island Arc: Geol. Soc. America Bull., v. 79, no. 5, p. 557–574, illus., tables, 1968.

The basal complex of Puerto Rico consists primarily of serpentinite, minor chert, spilite and amphibolite. Gneissic amphibolite at Las Palmas reveals a complex metamorphic history initiated by amphibolite facies regional metamorphism, foliation, and hornblende lineation. Increased intensity of metamorphism produced quartzo-feldspathic segregations, small-scale folding, and lineation oblique to the hornblende lineation. Nonfoliated but metamorphosed mafic dikes indicate a decrease in metamorphic intensity. With further decrease in metamorphic intensity kink-bands developed at high angles to the earlier folding. Later, the amphibolite was intruded by the serpentinite. Two favored interpretations of the gneissic amphibolite are: it represents old metamorphosed mafic rocks that are part of an extensive pre-late Cretaceous orogeny, or metamorphosed mafics that are part of the ocean crust.—*from* Author's abstract

Todd, William C. *See* Sainsbury, C. L. 01421

07024 **Toots, Heinrich.** Invertebrate burrows in the non-marine Miocene of Wyoming: Wyoming Univ. Contr. Geology, v. 6, no. 2, p. 93–96, illus., 1967.

Burrows of invertebrates referable to "Taenidium" have been found in massive sandstones of the Sheep Creek Formation near Wheatland, Wyoming. The burrows show an internal fabric indicating backfilling of abandoned parts of the burrow. The presence of the backfilling fabric supports assignment of the burrows to the feeding burrows (Fodichnia). The burrows are associated with lacustrine sediments and were formed either in very shallow parts of a lake or in a paludal environment

representing the transition from lacustrine to fluviatile (floodplain) sedimentation.—Author's abstract

Tozer, E. T. *See* Donovan, D. T. 07056

Trainer, Frank W. *See* Heath, Ralph C. 01511

01651 **Traverse, A.; Ames, H. T.; Kremp, G. O. W.** (compilers). Catalog of fossil spores and pollen—V. 28, Mesozoic megaspores, microspores and pollen: University Park, Pa., Pennsylvania State Univ. Palynol. Labs., 177 p., illus., 1968.

This volume contains protologs of 159 new taxa of specific or infraspecific rank and three new genera, which were originally described in nine papers published between 1935 and 1964 on Mesozoic spores and pollen from Australia, England, Netherlands, Mongolia, Greenland, Peru, and South Dakota. North American taxa are: 13 new species of *Triletes* from Rhaetic–Liassic coal beds of Scoresby Sound, East Greenland (T. M. Harris, 1935); *Wodehousia*, n. gen., with type species from the Upper Cretaceous Hell Creek Formation and another new species from the Paleocene Fort Union Formation, Harding County, S. Dak. (E. A. Stanley, 1961), and five new species of *Aquillapollenites* from the Hell Creek Formation, S. Dak. (Stanley, 1961).—VMJ

01358 **Trescott, Peter Chapin.** An investigation of the ground-water resources of the Annapolis–Cornwallis Valley, Nova Scotia [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 8, p. 3346B, 1968.

Trettin, H. P. *See* Blackadar, R. G. 01526

Trettin, H. P. *See* Blackadar, R. G. 01527

Trettin, H. P. *See* Blackadar, R. G. 01607

01646 **Trollinger, William V.** Surface evidence of deep structure in the Anadarko basin: Shale Shaker, v. 18, no. 8, p. 162–171, illus., 1968.

The surface of the Anadarko basin is composed of Upper Permian strata laid down subsequent to major regional orogeny; in places it is mantled by Tertiary continental beds and Quaternary deposits. A recent photogeologic–geomorphic evaluation involved comprehensive stratigraphic and structural mapping and revealed the degree of influence by structure and lithology. Many deep-seated structural anomalies were found to be reflected in drainage, landform, erosional, phototonal, and fracture patterns. The Wild RC–9 camera, with its 6.5X exaggeration, is especially well suited to mapping low dip, which in this case rarely exceeded one degree. Four producing areas—Cement, Apache, Gageby Creek, and Washita Creek Fields—are examined as examples of good surface expression.—GDC

07114 **Tsukada, Matsuo; Deevey, Edward S., Jr.** Pollen analyses from four lakes in the southern Maya area of Guatemala and El Salvador, *in* Quaternary paleoecology—Internat. Assoc. Quaternary Research, 7th Cong., 1965, Proc., V. 7: New Haven, Conn., Yale Univ. Press, p. 303–331, illus., table, 1967.

Six cores from four lakes are studies; two are at sea level in rain forest and two are from high altitudes. All cores are short; the oldest lake dates from about 1000 B.C. Zonation of the pollen diagrams is based upon correlations with Laguna de Petenxil in the Pétin. Zones numbered 2 (in all lakes but one) are called classic, zones 3a are post–classic, and zones 3b are post–colonial; these assignments are supported by C–14 dates. Carbonized fragments are generally more numerous than pollen, and agricultural pollen suggests that all of the changes seen are products of human disturbance. Details are described.—*from* Authors' abstract

01415 **Tucker, Ragan.** John Hestwood Casey (1923–1967): Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 501–503, portrait, 1968.

01359 **Turner, Brian Buddington.** Configuration and petrogenesis of a geologically critical area in the southeastern Adirondack Mountains, New York [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 28, no. 8, p. 3346B-3347B, 1968.

06985 **Turner, Francis J.** Thermodynamic appraisal of steps in progressive metamorphism of siliceous dolomitic limestones: Neues Jahrb. Mineralogie Monatsh. 1967, no. 1, p. 1–22, illus., tables, 1967.

The significance and order of certain possible reactions in siliceous limestones and dolomites are reassessed in light of recent thermochemical data. In absence of water the calculated order of appearance of common minerals with increasing temperature at constant partial pressure of CO_2 is diopside–wollastonite–forsterite–monticellite–periclase. At equal partial pressures of water and CO_2 the first mineral to appear should be tremolite or talc. For compositions within the calcite–dolomite–quartz triangle, talc should be followed by tremolite and this in turn should be eliminated in favor of diopside. Reactions representing stable equilibria and their relative order calculated from thermochemical data correspond closely with reaction sequences observed in metamorphic rocks. Some anomalies are discussed, notably the relative order of appearance of wollastonite and forsterite.—DBV

06960 **Ubaghs, Georges.** Le genre *Ceratocystis* Jaekel (Echinodermata, Stylophora) [with English abs.]: Kansas Univ. Paleont. Contr.—Paper 22, 16 p., illus., 1967.

Ceratocystis Jaekel (Middle Cambrian, Czechoslovakia) is the oldest known genus of the class Stylophora, which formerly was included as a superorder of the class Carpoidea and which comprises the orders Cornuta and Mitrata. Considered as an early somewhat specialized offshoot of the Cornuta, *Ceratocystis* is placed in a family Ceratocystidae Jaekel. The heterogeneity of the "Carpoidea" is emphasized.—Author's abstract

07060 **Ubaghs, Georges.** General characters of Echinodermata, *in* Treatise on invertebrate paleontology—Pt. S, Echinodermata 1, V. 1: New York, Geol. Soc. America (and Univ. Kansas Press), p. S3–S60, illus., 1967.

General characters of the main divisions of the phylum Echinodermata are discussed under morphology, ontogeny, physiology, and phylogeny—comparisons under the first three topics being based almost entirely on living forms. Under phylogeny, the affinities of echinoderms, origin and development of echinoderm organization, and origin and interrelations of echinoderm classes are discussed. A new classification system is outlined in which the phylum is divided into four subphyla: Homalozoa, including three classes of "carpoids" and possibly Machaeridia; Crinozoa, including Blastoidea, Crinoidea, Cystoidea, and five smaller classes; Asterozoa, with one class, Stelleroidea, containing three subclasses; Echinozoa, including Echinoidea, Holothuroidea, and four smaller classes.—VMJ

07126 **Ubaghs, Georges** Eocrinoidea, *in* Treatise on invertebrate paleontology—Pt. S, Echinodermata 1, V. 2: New York, Geol. Soc. America (and Univ. Kansas Press), p. S455–S495, illus., 1967.

The class Eocrinoidea Jaekel, 1918, was originally considered a subclass of Crinoidea, or the genera were distributed among Cystoidea. Eocrinoids have a continuous theca of incomplete pentaradiate symmetry, exothecal brachioles, and a column which is generally well differentiated. They are distinguished from cystoids by absence of thecal pores, or, where pores are present, by their alignment along the plate sutures. Resemblances to crinoids are only superficial; true arms are not present. Found in lower Lower Cambrian to Silurian rocks, eocrinoids are, with the helicoplacoids and edrioasteroids, the oldest known echinoderms; no descendants are known. Of the 24 genera, 17 are placed in 10 families; because phylogenetic significance of the characters is not adequately known, superfamilial classification is not attempted.—VMJ

07127 **Ubaghs, Georges.** Stylophora, *in* Treatise on invertebrate paleontology—Pt. S, Echinodermata 1, V. 2: New York, Geol. Soc. America (and Univ. Kansas Press), p. S495–S565, illus., 1967.

Stylophora Gill and Caster, 1960, a superorder of the class Carpoidea, is here raised to class rank in the subphylum Homalozoa. Stylophorans range from Middle Cambrian through Middle Devonian and are widespread. They are asymmetrical, with depressed theca bordered by elongate marginal plates. Attached to the anterior end of the theca is the aulacophore, a highly characteristic brachial process, in three parts, bearing the ambulacrum; it had both subvective and locomotor functions, unlike the steles of Homostelea and Homoiostelea. Stylophorans have no stele. There are two distinct orders: Cornuta, with three families and six genera; Mitrata, with three suborders, eight families, and 20 genera. Origin and relationships are unknown.—VMJ

07128 **Ubaghs, Georges.** Homostelea, *in* Treatise on invertebrate paleontology—Pt. S, Echinodermata 1, V. 2: New York, Geol. Soc. America (and Univ. Kansas Press), p. S565–S581, illus., 1967.

Homostelea Gill and Caster, 1960, a "carpoid" subclass, is here raised to class rank in the subphylum Homalozoa. It comprises but one order, Cincta, with two families, each with two genera, all restricted to the Middle Cambrian; other taxa have been reassigned to Eocrinoidea and Stylophora. Like other carpoids, Homostelea have an asymmetrical, depressed theca bordered by marginal plates; they differ from Stylophora and Homoiostelea in lacking a brachial appendage; they have a stele (lacking in Stylophora), but it differs from the Homoiostelea stele, being an immovable flattened, tapered extension of the theca. Grooves in the marginal plates, opening into the smaller of the two anterior orifices, probably housed food-gathering organs. Origin and phylogenetic relationships are unknown.—VMJ

07132 **Ubaghs, Georges.** *Cymbionites* and *Peridionites*—Unclassified Middle Cambrian echinoderms, *in* Treatise on invertebrate paleontology—Pt. S, Echinodermata 1, V. 2: New York, Geol. Soc. America (and Univ. Kansas Press), p. S634–S637, illus., 1967.

Cymbionites and *Peridionites* are monotypic genera proposed by F. W. Whitehouse (1941) for small, hemispherical forms consisting of calcareous skeletons of a few plates, found in lower Middle Cambrian strata in Australia. Whitehouse introduced new families and classes for the genera, and placed them in Haplozoa, a new subphylum of Echinodermata. Interpretations of these fossils by different authors, as here summarized, are extraordinarily different. Ubaghs here considers the genera to be echinoderms, but does not find sufficient evidence to assign them to classes or even to families.—VMJ

Underwood, J. R., Jr. *See* Southeastern Geological Society, 07096

01203 **Upchurch, Sam B.; Mackenzie, Fred T.** Bermuda carbonate platform—Quantitative analysis of depositional environments [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 553, 1968.

07091 **Upshaw, Charles F.** Pennsylvanian palynology and age relationships, *in* A field guide to Carboniferous detrital rocks in northern Alabama—Geol. Soc. America, Coal Div., 1967 Field Trip: University, Ala., Alabama Geol. Soc., p. 16–20, illus., table, 1967.

More than 90 palynomorphs were recognized in Pennsylvanian rocks of the Warrior basin, of which two are acritarchs and the rest plant remains. *Lycospora* and *Densosporites* are numerically most abundant. The assemblages resemble those of Morrowan age in the Midcontinent area; a list of 27 species is included. The Pottsville of Alabama is considered as Early and Middle Pottsvillian. Correlations with adjacent regions are made, based upon occurrences and ranges of taxa. In general, sections show overstepping of the base, thinning of units, and time transgression of lithology, all toward the northeast.—HRC

U.S. Bureau of Mines. *See* U.S. Geological Survey, 01408

01408 **U.S. Geological Survey; U.S. Bureau of Mines.** Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, 492 p., illus., tables, geol. map, 1968.

Mineral resources of the Appalachian region (West Virginia and parts of New York, Pennsylvania, Ohio, Maryland, Virginia, Kentucky, Tennessee, North Carolina, South Carolina, Georgia, and Alabama) have played a vital role in the industrial development and economic growth of eastern United States. These resources are evaluated in terms of geologic setting and distribution, availability and use. Fifty sections deal with the various mineral commodities, in four categories: fuels and related materials, construction materials, nonmetals, and metals. In 1964, mineral commodities produced in Appalachia were valued at about 2.5 billion dollars, bituminous coal accounting for 1.64 billion dollars. Many of the mineral resources of the region are still imperfectly known and systematic exploration is needed. Reports on geology and mineral commodities are cited separately.—MCM

01678 **U.S. Geological Survey.** Bibliography of North America Geology, 1963: U.S. Geol. Survey Bull. 1233, 1105 p., 1968.

01405 **VanHouten, F. B.; Savage, E. L.** Road log [for Trip C, The Triassic rocks of the northern Newark Basin], *in* Guidebook to field excursions—New York State Geol. Assoc., 40th Ann. Mtg., Flushing, N. Y., 1968: Brockport, N. Y., State Univ. Coll., Dept. Geology, p. 69–100, illus., 1968.

This is a log for a trip of over 66 miles, making seven stops, each examining a different facies of the Triassic rocks exposed in the northern part of the Newark Basin. It starts in the vicinity of Edgewater, Bergen County, N. J., at the base of the Palisades, goes northward to near Nyack, N. Y., thence westerly along the rim of the Palisades to the western boundary of the Newark Basin. The route then turns southward along the foot of the Ramapo Mountains to Suffern, thence eastward to the backslope of the Palisades, and finally southward to Granton, N. J.—HRC

Vaughan, R. H. *See* Waters, A. C. 01500

07042 **Vecchioli, John.** Directional hydraulic behaviour of a fractured-shale aquifer in New Jersey [with French abs.], *in* Hydrology of fractured rocks—Dubrovnik Symposium, 1965, Proc., V. 1: Internat. Assoc. Sci. Hydrology Pub. 73, p. 318–326, illus., 1967.

The principal source of ground water in a large part of central and northeastern New Jersey is the Triassic Brunswick Shale aquifer; large wells commonly yield several hundred gpm and virtually all ground water occurs in interconnecting fractures. Numerous pumping tests indicate the aquifer exhibits directional, rather than isotropic, hydraulic behavior; water levels alined along the strike of the formation show greater magnitude of interference than those in wells alined in transverse directions. Computed values of transmissibility may be unreliable owing to departure of the aquifer from the ideal model; it is even possible that the direction of minimum computed transmissibility is indicative of the alinement of fractures with greatest permeability. Well interference can be minimized, generally, by alining wells perpendicular to the strike.—*from* Author's abstract

01434 **Velde, B.** The effect of chemical reduction on the stability of pyrophyllite and kaolinite in pelitic rocks: Jour. Sed. Petrology, v. 38, no. 1, p. 13–16, illus., 1968.

It is postulated that hydrogen-rich gases released from sedimentary organic materials during diagenesis and early metamorphism reduce ferric iron to ferrous iron causing it to shift its position in the silicate minerals present. This causes the associated aluminum to shift also, ending up in mica and chlorite phases, rather than in pure aluminum silicate phases.—HAT

Verville, George J. *See* Sanderson, George A. 01193

01204 **Vest, E. L., Jr.** Pennsylvanian–Permian Horseshoe atoll, West Texas [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 553, 1968.

Vhay, J. S. *See* Cornwall, H.R. 01377

01205 **Viniegra, Francisco; Castillo-Tejero, Carlos.** Golden Lane fields, Veracruz, Mexico [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 553-554, 1968.

01423 **Wagner, Frances J. E.** Additional radiocarbon dates, Tyrrell Sea area: Maritime Sediments, v. 3, no. 4, p. 100-104, illus., table, 1967 [1968].

In a table of 33 localities, C-14 dates for raised beaches around Hudson Bay include some presented by Lee who gave the name Tyrrell Sea to the postglacial marine waters that deposited them (Science, no. 3413, 1960) and by Matthews (Nature, no. 5054, 1966). On the basis of age in relation to elevation, both reached comparable deductions on the rate of postglacial emergence. New dates, for samples collected by the writer from the Churchill area in Manitoba and northeastern Hudson Bay islands, fit well into the pattern of those published. From the dates plotted relative to position above present sea level, three curves follow the pattern of ice retreat and subsequent uplift in the northern, central, and southern areas. The latter was freed from ice earlier; its more scattered samples of corresponding ages are higher than in the northern parts.—GDC

Wagner, Walter R. *See* Lytle, William S. 07014

01659 **Wahrhaftig, Clyde.** Schists of the central Alaska Range: U.S. Geol. Survey Bull. 1254-E, p. E1-E22, illus., 1968.

Schist formations with axial plane cleavage and mineral foliation, lying in E-W trending belts of the central Alaska Range, are deformed into a broad arch having steep limbs. Its core, the Birch Creek Schist, is flanked on the north by the (here named) 2,500-4,000 feet thick Keevy Peak Formation, originally considered part of the Totatlanika Schist (Capps, 1912). The Totatlanika lies beyond the Birch Creek and is here divided into five new members; it is predominantly of marine and volcanic origin. Metavolcanic schists on the south flank are correlated with its Chute Creek and Mystic Creek Members. From *Syringopora*, found in a limestone lens in the Mystic Member, the Totatlanika is assigned a Mississippian(?) age. The other two formations are considered to be Precambrian or early Paleozoic.—GDC

01462 **Waite, Jerry M.** Anomalies in the thermoluminescence of the Austin chalk of Texas: Jour. Sed. Petrology, v. 38, no. 1, p. 253-255, illus., 1968.

The thermoluminescence of the Austin chalk of Texas is characterized by the same glow peaks throughout its areal extent except in the Bexar, Medina, and Uvalde County area where an additional glow peak is observed.—Author's abstract

01675 **Waldrop, L.** Crystal structure of triplite: Naturwissenschaften, v. 55, no. 4, p. 178, table, 1968.

The structure of triplite was determined for a single crystal from the Mica Lode pegmatite, Fremont County, Colo., using three-dimensional Patterson and minimum-functions maps. It crystallizes in space group $I\ 2/c$ and has cell dimensions $a = 12.065$A, $b = 6.454$A, $c = 9.937$A, $\beta = 107.09°$. Structure within a triplite unit cell constitutes the substructure for several other related phosphates.—ESL

01206 **Walker, Kenneth Russell.** Biogenic sedimentary structures in facies of Middle Ordovician Black River Group of New York State [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 554, 1968.

07075 **Walker, M. V.** Revival of interest in the toothed birds of Kansas: Kansas Acad. Sci. Trans., v. 70, no. 1, p. 60-66, 1967.

This is an historical account of the persons who have been involved in collecting and naming Cretaceous toothed birds. Marsh found the first one in 1870 and others a few years later, and eventually published a monograph. Later, Gregory restudied Marsh's material and recognized convergence with the mososaurs, especially in the jaws. The author studied these specimens (and others) in 1965. The mandible of *Hesperornis*, found in 1947, was also examined, and is probably the mandible of

a reptile. Some of the material of Marsh's *Baptornis* is restudied also. Other toothed birds are now known from different stratigraphic and geographic locations.—HRC

01624 **Walters, Kenneth L.; Kimmel, Grant E.** Ground-water occurrence and stratigraphy of unconsolidated deposits, central Pierce County, Washington: Washington Dept. Water Resources Water Supply Bull. 22, 428 p., illus., tables, 1968.

In an elongated trough underlying the southern Puget Sound Lowland, consolidated rocks are Eocene and Miocene in age; exposed only near the foothills of the Cascade Range, they yield water to few wells. Unconsolidated sediments range in age from Miocene to Holocene; the Miocene, exposed in the south and east, locally yields moderate quantities of water. Quaternary deposits, four major glacial intervals, include the most important aquifers, varying greatly in yield; most productive are in the Salmon Springs Drift, Vashon deposits, and Recent alluvium. Important flowing wells are in the Puyallup River valley and the Tacoma tidal flats. Generally of good quality, ground-water type in the uplands is calcium bicarbonate and in the Puyallup valley is sodium bicarbonate. Tables include well records and drillers' logs.—GDC

Wane, M. T. *See* Barla, G. 01619

01636 **Wang, Chi-Yuen.** Shock-wave data for several minerals and their implication to mineral phases in the lower mantle: Nature, v. 218, no. 5141, p. 560-561, illus., 1968.

The nature of the phase change in the lower mantle is investigated in light of shock-wave data on periclase, corundum, and the high pressure phases of spinel, forsterite, and quartz. The results show that the question of mineral phases in the lower mantle is still open.—DBV

07098 **Wanless, H. R.** Regional setting of the Alabama coal basins, *in* A field guide to Carboniferous detrital rocks in northern Alabama—Geol. Soc. America, Coal Div., 1967 Field Trip: University, Ala., Alabama Geol. Soc., p. 5-10, illus., 1967.

In the Warrior, Cahaba, Coosa, Blount Mountain, and Plateau coal fields of Alabama the thickness of Pennsylvanian rocks ranges from 50 feet in the northern part of the State to over 10,000 feet just north of Meridian, Miss. The boundaries of the field are described, including the adjacent Ouachita thrust zone. The term Pottsville is unfortunately used throughout the area for all of the Pennsylvanian rocks. Individual groups of strata are described, with their flora and correlations listed in part. More detailed work is suggested, including: (1) systematic paleobotanical collecting, (2) study of spore associations, and (3) a study of the marine faunas which are plentiful.—HRC

Wanner, Johannes. *See* Beaver, Harold H. 07125

07081 **Warren, Claude N.** The San Dieguito complex—A review and hypothesis: Am. Antiquity, v. 32, no. 2, p. 168-185, illus., tables, 1967.

The confusing terminology surrounding the San Dieguito complex is reviewed, and a critical evaluation of the [artifact] content of this complex is undertaken. The San Dieguito complex is redefined and includes Lake Mohave, Death Valley I, [Malpais] and Playa I and II complexes. An age of greater than 6000 B.C. is shown for at least one component of the complex and a date of 7000 to 8000 B.C. [based on C-14 dates] is suggested for the complex as a whole. The hypothesis is developed that the San Dieguito complex is distinct from the Desert culture and represents a generalized hunting tradition [associated with high stands of Pleistocene lakes] which moved into the area along a north-south belt in the western Great Basin.—Author's abstract

Warren, Claude N. *See* DeCosta, John. 07086

01500 **Waters, A. C.; Vaughan, R. H.** Reconnaissance geologic map of the Eagle Rock quadrangle, Crook County, Oregon: U.S. Geol. Survey Misc. Geol. Inv. Map I-540, scale 1:62,500, 1968.

Weakly, E. C. *See* Smith, F. A. 01642

01414 **Webb, Rieman Shaw.** David Ainsworth (1898–1967): Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 501, portrait, 1968.

07064 **Webb, S. D.** Pliocene terrestrial deposits of peninsular Florida, *in* Miocene and Pliocene problems of peninsula Florida—Southeastern Geol. Soc., 13th Field Trip 1967 [guidebook]: Tallahassee, Fla., Southeastern Geol. Soc., p. 12–17, illus., 1967.

Evolution of the Florida area from a shallow shelf to a peninsula is shown by Cenozoic rocks. The terrestrial sequence contains the only succession of land vertebrate faunas in eastern North America. Vertebrates of Pliocene age are found in either phosphatic sand or sandy montmorillonitic clay. The latter, typified by Mixon's Bone Bed and Sellard's Alachua Clay, filled sinkholes in Ocala Limestone. More common occurrences are in phosphatic sand, as in the Bone Valley district, which farther north fills parts of a karst surface. Fossil deposits, middle Pliocene?, occur at: 100–150 feet usually in fluviatile deposits; 70–100 feet showing an estuarine influence; and present sea level, having marine and estuarine vertebrates mixed with the terrestrial. From the Oligocene on, western taxa extended their range into Florida, and species that became extinct in contiguous areas were preserved.—ESL

01470 **Weber, Jon N.** Quantitative mineralogical analysis of carbonate sediments—Comparison of X-ray diffraction and electron probe microanalyzer methods: Jour. Sed. Petrology, v. 38, no. 1, p. 232–234, illus., 1968.

X-ray diffraction determination of proportions of high magnesium calcite and low magnesium calcite in samples of carbonate sediment was checked by microprobe analyses of grains for calcium, magnesium, and strontium. It was confirmed that other methods of determination overestimate the amount of low magnesium calcite in such materials.—HAT

Webster, G. D. *See* Lane, N. Gary, 06963

01328 **Wedow, Helmuth, Jr.; Stansfield, Robert G.** Fertilizer raw materials, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 281–286, illus., tables, 1968.

Brief descriptions of the origin and occurrence of fertilizer materials, namely potassium, nitrogen, and phosphorus, are given. None is currently being produced, but some known deposits are described in tabular form.—HRC

01331 **Wedow, Helmuth, Jr.; Heyl, Allen V.; Sweeney, John W.** Zinc and lead, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 450–466, illus., tables, 1968.

Sphalerite and galena occur throughout the region, but are primarily important in Virginia and Tennessee in the Valley and Ridge province. They occur primarily in dolomite and limestone, filling pores and fissures, and as a replacement material in various shapes. Brief descriptions of the occurrences are given.—HRC

01373 **Wedow, Helmuth, Jr.; Sweeney, John W.** Talc, soapstone, pyrophyllite, and sericite schist, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 355–361, illus., tables, 1968.

These resources occur in Alabama, Georgia, and North Carolina, primarily in Piedmont metamorphic rocks. Various deposits are described cursorily, largely in tabular form, and little new information is included.—HRC

01374 **Wedow, Helmuth, Jr.; Hobbs, Robert G.** Zirconium, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 361–364, illus., table, 1968.

A cursory description of the occurrence of zircon in Appalachia is given. Zircon occurs locally as concentrates in the saprolite and as placer deposits; although none is being actively mined at the present time, production has come largely from North Carolina and Tennessee.—HRC

01418 **Weeks, Lewis G.** The gas, oil and sulfur potentials of the sea: Ocean Industry, v. 3, no. 6, p. 43–51, illus., tables, 1968.

Hundreds of companies are exploring the continental shelves of 70 countries for oil and gas; 20 countries are already producing. The known volume of world offshore reserves is 85 billion bbls, and current offshore production is 5.6 million bpd. Some potential resource estimates are made. Offshore sedimentary rocks are of Mesozoic–Tertiary age and these have a record of greater average yield. Examples of outstanding offshore successes are given. Grand Isle salt dome off the Louisiana coast is the only present offshore producer of sulfur; other domes are being tested. Much larger sources of sulfur exist in molecularly combined forms such as gypsum, anhydrite, etc. Other major offshore mineral resources include those in sea water, in sands and placers, and in low-temperature sedimentary deposits.—ESL

Weir, Gordon W. *See* Peck, John H. 01335

01368 **Weis, Paul L.; Feitler, Stanley A.** Graphite, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 303–307, illus., tables, 1968.

Graphite occurs as a minor constituent in many of the rocks of Appalachia, but the principal deposits are those of Alabama. Brief descriptions of some of the deposits are given, although no new data are included.—HRC

Weiser, D. *See* Moiola, R. J. 01478

Weiss, N. O. *See* Allan, D. W. 07101

07141 **Wendler, G.** Heat flow by conduction and latent heat in volcanic soil of Mt. Wrangell, Alaska [with German summ.]: Pure and Appl. Geophysics, v. 68, no. 3, p. 41–48, illus., table, 1967.

In August 1966, temperature profiles in the volcanic soil of Mt. Wrangell (4160m) were measured and the boiling point was found at depths between 20 and 80 cm. The measurements indicated that at least 50 percent of the heat transport is caused by latent heat, the same order of magnitude which is expected from theoretical considerations.—Author's abstract

01645 **Whitcomb, Harold A.; Lowry, Marlin E.** Ground-water resources and geology of the Wind River basin area, central Wyoming: U.S. Geol. Survey Hydrol. Inv. Atlas HA-270, 3 sheets, scale 1:250,000, sections, separate text, 1968.

Sheet 1 is a geologic map, sheet 2 a hydrogeologic map showing generalized piezometric contours and spring and well locations, and sheet 3 contains a generalized section of the geologic formations. Artesian conditions are prevalent in the Wind River Formation and older sedimentary rocks. Water in an unconfined condition occurs in outcrop areas of artesian aquifers, in the Arikaree Formation, and in alluvial and windblown sand deposits. Physical and water-bearing characteristics of the formations are summarized on sheet 3. Chemical quality of the water varies greatly.—MCM

White, I. G. *See* Harris, P. G. 07144

01391 **White, Stan M.** Distribution of glauconite-boron association in continental-shelf sediments [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 555, 1968.

01498 **Widdison, Jerold G.** William H. Holmes [1846–1933]—Premier artist of Grand Canyon: Arizona Highways, v. 44, no. 6, p. 4–9, illus., portrait, 1968.

Williams, A. *See* Ager, D. V. 07073

01593 **Williams, E. P.** How oil, gas hopes measure up on Prince Edward: Oil and Gas Jour., v. 66, no. 22, p. 156–158, 160, illus., 1968.

Oil and gas occur in rocks of Mississippian age at scattered localities in the Maritimes basin of eastern Canada. Prince Edward Island, centrally located in the basin, is underlain by a highly variable thickness of Permo–Carboniferous rocks which rest on a structurally warped and faulted pre–Carboniferous basement. Four wells drilled on the island have penetrated rocks of Mississippian age at depths ranging from 4,625 feet to 14,696 feet. None was successful in finding gas or oil.—HHA

01411 **Williams, G. D.** Shale chemistry as an environment indicator [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 555, 1968.

Williams, J. B. *See* Wozab, D. H. 07043

01486 **Williams, J. Stewart; Milligan, James H.** Bedrock configuration and altitude, Red Rock Pass, outlet of Lake Bonneville, southeastern Idaho: Wyoming Univ. Contr. Geology, v. 7, no. 1, p. 67–72, illus., 1968.

The bedrock threshold over which the Lake Bonneville emptied is covered by post–Bonneville alluvium and colluvium. A 12-channel seismograph was used to determine the exact position, configuration, and altitude of the original pass. The elevation of the crest probably exceeds 4,755 feet by one or two feet over most of the length. The width of the channel on the crest is about 800 feet. The threshold trends N. 85° W., oblique to the channel, which trends N. 30° W. The slopes approaching the threshold are steeper on the east side of the channel, perhaps indicating that the threshold is slightly lower on the east end, and that in the last stages of flow, the stream was at the east side of the channel. The depth of the fill on the threshold is about 20 feet.—*from* Authors' abstract

01682 **Williams, Roy E.** Graduate studies in hydrogeology and hydrology at the University of Idaho: Ground Water, v. 6, no. 3, p. 19–20, illus., 1968.

The interdisciplinary graduate program in hydrogeology at the University of Idaho is described. The curriculum is structured to permit the design of individual study programs which are in keeping with multiple use concepts. Flexibility sufficient to permit courses to be taken in several fields which support the students' major area of research is provided. This flexibility is maximized by the offering of two degree options. Discussion of a number of the research projects at the University illustrates several of the types of problems now being studied.—Author's abstract

Winchester, J. W. *See* Schilling, J. G. 07105

Windom, Herbert L. *See* Dymond, Jack. 01531

01625 **Winner, M. D., Jr.; Forbes, M. J., Jr.; Broussard, W. L.** Water resources of Pointe Coupee Parish, Louisiana: Louisiana Geol. Survey and Dept. Public Works Water Resources Bull. 11, 110 p., illus., tables, 1968.

Large quantities of fresh ground water are obtainable throughout the Parish from a series of at least 12 southerly dipping sand and gravel beds to maximum depths ranging from 500 to over 2,600 feet below sea level; some beds are over 250 feet thick and are capable of yielding 1,000 gpm. Below these aquifers are sands bearing saline water suitable for industrial use. The surface water resources of the Mississippi–Atchafalaya–Old River waterway system are discussed also. Three geologic sections, seven maps showing thickness and altitude of the base of sands, and two maps showing depth lines and cross sections of Raccourci Old River and False River accompany the report.—ESL

07119 **Wise, Donald U.; Grauch, Richard I.** Regional joint pattern superimposed on metamorphic rocks of southeastern Pennsylvania: Pennsylvania Acad. Sci. Proc., v. 40, no. 2, p. 104–110, illus., table, 1967.

An orientation study of major fracture directions associated with the final period of kink folding of the metamorphic Piedmont was conducted by measuring 100 master joints (greater than 100 sq ft of exposure) in each of 14 areas in the Susquehanna curve of the Appalachians. Steep dips dominate all plots. Most plots show a major symmetry plane, presumably containing the major stress axis, striking N. 15°–35° W. with conjugate fractures striking NNE and NW. Commonly, a third fracture set strikes perpendicular to the symmetry plane. The relatively constant orientation of this plane, despite strong curvature of the Appalachian Arc through the same area, indicates late stage stress trajectories were regional in nature and relatively independent of local strike of this segment of the Appalachians.—Authors' abstract

Witherspoon, P. A. *See* Mast, R. F. 01519

01383 **Withington, C. F.; Fish, George E., Jr.** Gypsum and anhydrite, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 206–210, illus., tables, 1968.

A brief description of the origin and occurrence of gypsum and anhydrite in Appalachia is given; no new data are included. The only currently commercial deposits occur in Mississippian rocks in Virginia, although other smaller deposits are known throughout the region.—HRC

01551 **Wones, D. R.; Gilbert, M. C.** The stability of fayalite: Carnegie Inst. Washington Yearbook 66, 1966–67, p. 402–404, illus., 1968.

The reaction $3Fe_2SiO_4 \pm O_2 = 2Fe_3O_4 + 3SiO_2$ was studied at 600°, 700°, and 800°C at 800 bars pressure, and at 700°C at 2,000 bars total pressure. The results are given by log $fO_2 = -25660/T + 8.92$. The estimated heat of reaction over the temperature range 600°–800°C, −117,400±2,500 cal, appears to agree with published heats of reaction. One result of this study is to shift the fO_2–T curve for the oxidation of fayalite to somewhat higher fO_2 values compared with those given in Eugster and Wones (1962).—MST

01592 **Wood, J.** Township U, District of Kenora: Ontario Dept. Mines Prelim. Geol. Map P. 468, scale 1 in. to 1/4 mi., text, 1968.

Oldest Precambrian rocks in Township U occur as inclusions in Archean granitic rocks, original volcanics are represented by biotite- or hornblende-feldspar schists, and original sediments by quartz-biotite-feldspar schists and gneisses. Schistosity strikes generally NW and outcrop pattern would suggest this is a pregranite trend. Three granitic rock types, all biotite and granite-adamellite in composition, have been recognized. Overlying the granites unconformably are the Gowganda and Lorrain Formations, whose contact, nowhere visible, is probably conformable. Two periods of diabase intrusion are evident. In the Cenozoic the area was glaciated, probably several times. A reconstruction of pregranite stratigraphy indicates a NW-trending folded sequence of volcanics and sediments; post-Huronian tectonism resulted in a series of NW- and NE-trending faults. Sulfide mineralization is of minor economic importance.—MCM

01665 **Wood, J.** Township Q, District of Algoma: Ontario Dept. Mines Prelim. Geol. Map P. 474, scale 1 in. to 1/4 mi., text, 1968.

Oldest Precambrian rocks in Township Q occur as inclusions in the Archean granitic rocks; schistosity strike and outcrop pattern generally trend northwest. Lying unconformably on the granites are sedimentary rocks of the Gowganda and Lorrain Formations. Huronian rocks were intruded by diabase sills and the underlying basement rocks by diabase dikes. Northwest-trending Keweenawan olivine diabases cut both basement and Huronian rocks. The area was glaciated several times in the Cenozoic. A NW- trending folded sequence of volcanic and sedimentary rocks is indicated; post-Huronian tectonism has resulted in a series of NW- and NE-trending faults. Early diabases have small amounts of disseminated sulfides; sand and gravel deposits, some quite extensive are found, but none are easily accessible.—MCM

07003 **Wood, J. A.** The early thermal history of planets—Evidence from meteorites, *in* Mantles of the Earth and terrestrial planets (S. K. Runcorn, editor): London and New York, Interscience Publishers, p. 3–14, illus., table, 1967.

Metallic minerals in iron meteorites contain a highly variable concentration of Ni. Calculations which take account of Fe–Ni phase diagrams and the coefficient of diffusion of Ni have been used to determine the rate at which the meteorites cooled. The technique can be extended to stony meteorites that have undergone metamorphism as they passed through a period of high temperature, from which it appears that both types of meteorite have comparable cooling histories. As meteorites represent broken pieces of alien planets in a very primitive state, it is evident that the early events which affected planets involved a great deal of heat. Possible sources of heat are considered.—JPF

01647 **Wood, John W.** Geologic map of Apache Mountains and vicinity, Culberson County, Texas: Texas Univ. Bur. Econ. Geology Geol. Quad. Map 35, scale 1:63,360, section, separate text, 1968.

The Apache Mts., an exhumed Permian reef complex, form a segment of the Delaware basin and a part of the Diablo platform. Regional structure is dominated by the Delaware uplift and the Salt Basin half-graben. Features of the western sector are folds and faults, and of the eastern sector, the Apache anticline, folds, normal faults, and grabens. Permian rocks from Victorio Peak Limestone to Rustler Formation correlate closely with adjacent regions—Delaware basin, Guadalupe Mts., and Sierra Diablo. Cretaceous rocks—Yearwood Formation, Cox Sandstone, Finlay Limestone, and Boracho Formation—are mainly isolated exposures. The Cenozoic is present in Tertiary bolson deposits and Quaternary gravel and alluvium. Mineral resources are barite, zinc, road material, petroleum and ground water.—MCM

07043 **Wozab, D. H.; Williams, J. B.** Flow problems in limestone plains, Jamaica, W. I.—A progress report [with French abs.], *in* Hydrology of fractured rocks Dubrovnik Symposium, 1965, Proc., V. 1: Internat. Assoc. Sci. Hydrology Pub. 73, p. 402–409, illus., 1967.

The Pedro Plains on the southwest coast of Jamaica are a low-lying, partially karstified limestone terrain sloping northwards into a wide swamp; the lower Miocene limestones show a variable lithology and are extensively faulted. Plains and swamp can be considered as a single structural and hydrologic unit. The water table is flat with the exception of mounds along several faults; the mounds and a marked concentration of flow towards the north emphasize the influence of structural control on ground-water movement. It is tentatively concluded that the recharge source is external and reaches the Plains under confined conditions through a faulted and karstified limestone horizon; unconfined ground-water distribution is also apparently fault controlled, although some movement takes place through a previously established system of karst drainage.—*from* Authors' abstract

Wright, A. D. *See* Ager, D. V. 07073

Wright, C. W. *See* Donovan, D. T. 07056

01412 **Wright, Frederick F.** Environment of glauconite on continental slope of California [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 556, 1968.

01380 **Wright, Wilna B.; Guild, Philip W.; Fish, George E., Jr.; Sweeney, John W.** Iron and steel, *in* Mineral resources of the Appalachian region: U.S. Geol. Survey Prof. Paper 580, p. 396–416, illus., tables, 1968.

A short summary of the vast iron deposits in Appalachia is given. The ore occurs primarily in Silurian Clinton rocks throughout the region; a few other types are present, residual limonite being the most important. No new details are given, however.—HRC

Yeend, Warren E. *See* Peterson, Donald W. 01420

Yoder, H. S., Jr. *See* Huckenholz, H. G. 01537

Yoder, H. S., Jr. *See* Schreyer, W. 01546

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Yoder, H. S., Jr. *See* Tilley, C. E. 01566

Yoder, H. S., Jr. *See* Tilley, C. E. 01567

01570 **Yoder, H. S., Jr.** Akermanite and related melilite-bearing assemblages: Carnegie Inst. Washington Yearbook 66, 1966-67, p. 471-477, illus., 1968.

The limits of stability imposed on rocks that contain a melilite rich in akermanite have bearing on one of the major magma trends, originating with olivine melilite nephelinites. Kimberlite may be derived at high pressure from a hydrous magma rich in melilite. The position of akermanite relative to its related phases, and the stability field based on gas-media experiments are shown in diagrams and discussed. Since the occurrence of an olivine with a melilite places further restrictions on the stability of melilite-bearing rocks, the akermanite-forsterite reaction is considered at some length. The incompatibility of akermanite and albite has great importance where melilite and plagioclase form from independent magma series; preliminary experiments at 10 kb demonstrate that they remain incompatible.—ESL

01571 **Yoder, H. S., Jr.** Albite-anorthite-quartz-water at 5 kb: Carnegie Inst. Washington Yearbook 66, 1966-67, p. 477-478, illus., 1968.

Since most granitic rocks contain an anorthite component, it is desirable to know its effects on the simplified granite system, orthoclase-albite-silica-water. Data for albite-anorthite-silica at one atmosphere are replotted, and results of reconnaissance runs on albite-anorthite-silica-water are presented. Significant observations are: the presence of anorthite produces a relatively small increase in temperature at which coprecipitation of plagioclase and quartz occurs, and the quartz content of the liquids decreases with fractionation. The narrow temperature interval between the initial coprecipitation of plagioclase and quartz and the solidus is of special interest.—ESL

01525 **Young, Edward J.** Spectrographic data on cores from the Pacific Ocean on the Gulf of Mexico: Geochim. et Cosmochim. Acta, v. 32, no. 4, p. 466-471, illus., tables, 1968.

Average quantitative spectrographic data are presented for V, Ti, Zr, Ni, Co, Sc, Cr, and La in 23 near-shore cores, mostly from the Gulf of Mexico and from the following Pacific deep-sea cores: 3 siliceous oozes, 6 red clays, 3 volcanic muds, 3 calcareous oozes, and 1 manganese nodule.—*from* Author's abstract

Zähringer, J. *See* Kaiser, W. 01529

06994 **Zamyslova, Ye. A.** Drevniy chelovek v Severnoy Amerike (obzor literatury): Akad. Nauk SSSR Kom. Izucheniyu Chetvertich. Perioda Byull. 34, p. 107-119, illus., tables, 1967.

This review gives a brief history of Paleolithic finds in North America, and discusses the areas of distribution of Paleolithic cultures, the chronological succession of the ancient cultures, and the age of fossil man and the problem of the settlement of the American continent.—DBV

Zigic-Toshich, Darinka. *See* Briggs, Louis I. 01229

01413 **Zigic-Toshich, Darinka; Briggs, Louis I.** Facies structure based on functional classification of stratigraphic components [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 3, p. 556, 1968.

01452 **Zimmerman, R. A.; Amstutz, G. C.** Southeast Missouri geology—Details from Annapolis area and Ketcherside Gap, Missouri: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 4, p. 703–708, illus., 1968.

New details on the Precambrian rhyolites and Upper Cambrian sedimentary rocks indicate that the tectonic style of the St. Francois Mountain area most probably can be compared with plateau (cratonic) areas and not with orogenic areas. The porphyritic rocks are in much the same position as when they formed. Depositional and lithologic features of the sediments across the pronounced Precambrian topographic relief suggest the sediments were deposited around and on the Precambrian knobs without later horizontal movements.—WLA

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